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FOOD MANUFACTURE

Incorporating Canning, Packing and Preserving.

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The Editor will be glad to consider contributions from those engaged in the Food Industry. Articles intended for publication should be of a practical nature and accompanied by photographs or drawings when possible.

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FOOD MANUFACTURE

Vol. X, No. 3 March, 1935

Food Technology

THE PRESENT issue is somewhat more specialised than usual in that it is divided between two topical subjects, cold storage and freezing of foodstuffs on the one hand and the training of the food technologist on the other.

With regard to the latter, it has not been found possible in the space available to publish more than a small part of the paper on the Training of the Food Technologist, which was presented to a meeting of the Food Group on February 13. This first part, however, opens with a brief statement of the main points of the thesis, which will be elaborated in later instalments. In this issue it has been thought to be more important to give a summary of the various views which were expressed at the meeting and also those which were communicated in the course of correspondence. These will provide interesting and instructive reading.

It will be noticed that, so far, there are no statements representative of the viewpoint of the industries concerned. This now remains to be remedied, and we look forward to receiving expressions of opinion from our readers.

Food Interest at the B.I.F.

By the time this issue reaches the hands of our readers the 1935 British Industries Fair will have entered on its last day. In spite of the really excellent arrangement of the stands, it was still very difficult "to see the wood for the trees", for after twenty years the Fair has grown out of all recognition.

To give a comprehensive review is quite impossible, and we shall here content ourselves with a few general remarks. Notes on a few individual stands appear in our news columns on another page.

FOOD MANUFACTURE and its associated journals *The Food Industries Weekly*, *Paint Manufacture*, and *The Manufacturing Chemist* occupied a prominent stand adjoining the Chemicals Section in the Grand Hall, where representatives were kept busy answering numerous enquiries.

Scotland

Perhaps the most outstanding exhibit in the foodstuffs section was that of Scotland. Here was to be seen a truly remarkable variety of foods, both national and general, from haggis to kippers and peas, packed, and here is the important point, in novel and unusually attractive ways. Many items came under the Scottish National Mark as distinct from the British, and, although we know comparisons are always supposed to be odious, we couldn't help feeling that the English stand opposite was eclipsed.

On this Scottish stand were to be seen Loch Fyne salt herring in large circular waxed cartons and Herrideen salt herring packed in most attractive-looking barrel-shaped glass jars holding eight fish. Loch Fyne kippers are now packed in square cartons, a very neat way of dealing with this fish which, through no fault of its own, seems to have become a music-hall joke.

New fruit packs which we saw on this stand were blaeberries and cranberries, and we were told that "Angus Brand" strawberries had caught the eye of the Duchess of York. And well they might! It was a fine pack.

We must be excused for seeming to have taken up our abode in the Highlands but, as we said, it is impossible to review the whole gigantic show, and this was certainly one of the most striking stands in the foodstuffs section. For further news please turn to page 103.

Fruit Preservation

On March 5, at 7 p.m., Mr. T. N. Morris is to give a lecture at the Chelsea Polytechnic on the preservation of fruit by canning and freezing. This will be the final lecture of a series of six which have been given by members of the Low Temperature Re-

search station, Cambridge, on various aspects of fruit preservation.

At the first, on January 29, Dr. J. Barker opened the subject with a general discussion of the factors which are involved in a study of the storage of fruit. He dealt with the principles of respiration, the rates of ripening, and the means employed to retard the ripening process. This led to a consideration of the elements of cold storage and gas storage as applied to fruit, and particularly apples. He referred, also, to the active emanation, ethylene, which is given off in minute quantities by ripe apples and which will start the ripening of green apples. These will ripen more rapidly in air drawn over ripe apples; it is as though " age is jealous of youth ", said the late Sir William Hardy. Advantage is being taken of this curious phenomenon in developing a storage method, on the converse principle, to retard ripening by absorbing the ethylene immediately it is produced, so that it does not have an opportunity of exercising its accelerating effect on the fruit in store.

By means of a chart, Dr. Barker then traced out the various factors, grouped as pre-storage, storage, and post-storage, which control the quality and storage life of fruit. For example, he dealt with the influence of climate, soil, orchard hygiene, the temperature, humidity, and composition of the atmosphere of the store, and so on.

Physiological Diseases

In the second lecture, Dr. Barker discussed the various types of physiological, or functional, diseases to which apples are subject. These, at times, cause serious loss in cold storage. One of the most characteristic features of severe disease is a browning of the tissues, as in scald, internal breakdown, and brown heart, denoting injury of the tissue cells. Dr. Barker produced browning of a banana by rubbing the skin, and he also produced a similar discoloration by placing a banana in a jar of chloroform vapour. It is unfortunate that the classification of these diseases has been based upon the appearance and distribution of the affected tissue, and not upon the causal conditions. Browned tissues of very similar appearance may result from widely different causes.

The lecturer enquired into the cause of low temperature injury and then went on to examine the characteristics of the main types of disease.

Fungal Rotting

The third lecture, delivered by Dr. R. G. Tomkins, dealt with the rotting of fruit in storage, due to attack by fungi. Dr. Tomkins gave a graphic account of the way in which the mycelia of fungi invade the fruit and, by means of enzymes which they secrete, dissolve away the cell walls. Where do these fungi come from? This question was answered by discussing the various possible sources of contamination, such as certain parts of the tree in the orchard, the boxes used for packing, and the brushes used for polishing. Next the lecturer examined the various means of prevention and, also, the influence of factors such as type of soil, temperature, humidity, carbon dioxide, sulphur dioxide, ammonia, and so on. Wrapping usually has a beneficial effect by cutting down " contact " infection. Dr. Tomkins reviewed and commented upon the various kinds of wraps which were in use or had been suggested. At the close of the meeting, as on the two previous occasions, some of the points were illustrated by demonstrations.

Cereal Enterprise

The other day we were privileged to be present at the opening of the new Woodlands Laboratories at Dover devoted to the investigation of the many problems of Cereal Chemistry. This branch of science is relatively new, and most of its development has occurred in the last twenty-five years. It is obvious, therefore, that any laboratory devoted to this subject is in a constant state of flux; ideas change rapidly, new methods are evolved almost every week, and what have formerly been regarded as fundamental conceptions are always liable to be scrapped at any moment.

Knowing the energy and enterprise of the Director, Dr. Kent-Jones, we expected to find the last word in equipment and the most up-to-date methods being used. Nor were we disappointed. Probably the most interesting, and certainly the most modern, section was the wheat testing laboratory. This room had been specially constructed with double walls and, being equipped with devices to maintain constant temperature and humidity, was ideal for the study of wheat and flour under constant conditions.

Mechanical Testing

The modern conception in testing flours is to eliminate the human element and to obtain numerical expressions of quality and strength by mechanical means under rigidly standardised conditions. Thus in this specially designed room we found a small model mill constructed, not so much to give results comparable with large scale milling, as to mill samples of wheat always in the same way, so

that they can be compared strictly the one with the other. By this means flours that have been milled in the same way and at the same temperature and humidity are obtained. These are made into doughs and moulded into discs of standard size which are placed in a Chopin Extensimeter and blown into a bubble until it bursts. The behaviour of the dough during this stretching treatment is automatically recorded on a graph (examples will be shown in our next issue) and from the form of this graph it is possible to make a comparison of the physical characteristics of various doughs. In these graphs " distensibility " (degree of stretching up to the point of rupture) is proportional to the horizontal co-ordinate, while " stability " (stiffness or resistance to stretching) is proportional to the vertical co-ordinate. The total area of the graph represents the general strength of the dough, while the rectangular area (see graphs) is proportional to its springiness (the " elasticity " of the baker).

Farinography

Additional information which throws much light on the nature of the flour and the dough made from it, and also its behaviour on fermentation, is obtained by means of two other ingenious instruments, the Brabender Farinograph and Fermentograph. It is interesting to note that a paper by Brabender appeared in the last issue of *Cereal Chemistry* under the title " Six Years' Farinography ". The paper describes six years' work on testing the baking value of flour by mechanical means. It is stated that in Europe it is difficult to estimate flour behaviour by a baking test on account of the many varieties of wheat that must be dealt with, thus necessitating many different baking methods and different types of bread. That, in Brabender's view, is the reason why the baking test as a means of determining flour quality has been largely abandoned, and why so many attempts have been made to develop methods of flour testing by mechanical means. There have been the Hankoczy Farinometer, the Chopin Extensimeter, the Bühler Comparator, and finally the Brabender Farinograph has appeared. This instrument measures dough quality and gluten strength dynamically rather than statically, as has been the case with all previous devices. Brabender's doctrine is that it is not necessarily the aim of a miller to make the best flour, but rather to make a uniform flour and also one that is well balanced between fermentation requirements and highest rate of gassing power, and he claims that his machine puts the scientific miller in a position to do this.

The Baking Test

Will these mechanical devices eliminate the time-honoured baking test? In most flour mills the inspection of the test bakes is a solemn ritual carried out with profound unction. Opinions are varied as to the value of this test. Obviously the main fault lies in its reliance on the human element. The skill of the test baker has a lot to do with the loaves obtained, and his skill is directly proportional to the state of his liver! Much work has been done in America in standardising the baking test, and everything that can be fixed *is* fixed, but even then we are still left with the chief variable factor—the baker. In this country, while the baking test is at present accepted as the most valuable criterion of flour quality, it is generally considered to be unsatisfactory. It should be possible to forecast exactly what will be the nature of a loaf from any given flour by a critical examination of the results of a number of purely mechanical measurements. We will not go so far as to say that that happy state has yet been reached, but from what we saw at Dover we feel sure that a very definite move is being made in this direction. It must be realised that commercial baking is itself becoming largely mechanical, and in all probability the judgment of a commercial flour from a consideration of mechanical data will be more valuable than one based on a test bake carried out by a human being.

Millers, Bakers and Chemists Present

A pleasing feature about the gathering at the Woodlands Laboratory was the close correlation between miller, baker and chemist. Many millers and bakers were present, and the various scientific tests carried out were explained to them in everyday terms. The chemist came out into the open and gave his account in homely terms instead of, as so often happens, lapsing into that academic jargon that confuses but does not educate. This we feel is a step in the right direction. The chemist has far too long remained in his laboratory browsing among his test tubes and other gear. The time has come for him to take his proper part in the organisation of industry, and to do this he must be capable of making himself and his work understandable to business men who don't know the difference between H_2O and H_2SO_4 and are only concerned with any differences when they might affect their business. Something of this sort is being achieved at Dover, and we wish the venture all success.

Ice-Cream

In the days when "Hokey Pokey Penny a Bar" was a familiar London street cry nobody bothered very much about the composition of the sweetmeat. Things are changing, and the City of London Analyst has had something interesting to say about it in his last annual report. He points out that the consumption of ice-cream has greatly increased during the last few years, and regrets that there is no legal definition or standard of quality for it. He analysed twenty-eight samples taken in the City and found a very wide range in the percentage fat content, which bore little relationship to the price charged. Thirteen of the samples, purchased at restaurants, had a fat content ranging from 8·5 to 24·4 per cent., with an average of 13·5 per cent. Fifteen samples taken from itinerant vendors—the real hokey pokey merchants—had an average fat content of only 2·6 per cent. It may reasonably be submitted that ice-cream should have a milk fat content of at least 8 per cent., and should consist of butter fat, milk-solids-not-fat, sugar, gelatin and water. In the City of London Analyst's view mixtures consisting mainly of milk, sugar, cornflour, eggs, etc., should be permitted to be sold, not as "ice-cream", but under an appropriate designation such as "ice" or "ice custard".

In this connection we were most interested to hear the views of a number of other authorities on this most important subject expressed at the recent Discussion on "Bacteriological and Other Standards for Ice-Cream" at the Royal Sanitary Institute and summarised on pages 83-85 of the present issue.

Preventing "Ropiness" in Bread

The troublesome phenomenon which manifests itself occasionally as "ropiness" in bread is due to the spores of certain bacteria which are able to withstand the temperature and ordinary conditions of baking processes. The spores subsequently develop and give rise to the "ropiness". Dr. V. Stuchlik of Trenčin, Slovakia, has just published in *Chemický Obzor* (January 31, p. 4) a method by which he has overcome the trouble. If the infected flour is mixed with a suitable amount of lactic acid to produce an acidity equivalent to *p*H = 4·60 "ropiness" does not develop, since the spores are unable to withstand heat in a medium of this acidity. Bread made from even strongly infected flour treated in this way was found to develop no "ropiness".

Artificial Colouring of Fruit

The Annual Report of the Government Analyst for Queensland contains a very interesting reference to the artificial coloration of fruit by means of gases. He points out that the practice of leaving green, unripe fruit for a short time, generally overnight, in an atmosphere containing certain gases has recently been widely adopted. Most citrus fruits are now being changed from a green to a yellow colour in this way, while a proportion of bananas and pineapples is also being treated. The appearance of ripeness, however, is entirely fictitious, except when the gas is used as part of a complete ripening process. When used by itself, the treatment leaves green, sour, unripe oranges still sour and unripe, and hard, unripe bananas still hard and unripe, despite their deceitful attractive yellow skins. There is no question that in such cases the practice is fraudulent, as the sole object is to give unripe fruit the appearance of being ripe and so to deceive the buyers. There is already evidence that some customers are noticing the unripe quality of certain fruits of ripe appearance, and are buying less fruit. It is unfortunate that the scientific discovery of the influence of ethylene and other gases on the ripening of fruit should be prostituted in this way.

Fruit Preservation

An interesting and important lecture on fruit ripening by means of ethylene was given by Dr. R. Gane at the Chelsea Polytechnic, London, on February 26. This was one of a series of six weekly lectures on fruit preservation given by members of the Low Temperature Research Station, Cambridge. The last, by Mr. T. N. Morris, is to be given on March 5, and will be concerned with the preservation of fruit by canning and freezing.

We take this opportunity of announcing two important forthcoming articles on citrus fruits. One deals with the prevention of wastage by moulds, the use of liquid and gaseous fungicides being described; the other concerns citrus maturity tests. An article on the preservation of orange juice appears in the present issue.

Our Enquiries

Owing to unusual pressure on our space in this special Refrigeration Issue our Enquiry section has had to be entirely omitted. This feature will be resumed in the next issue, when we hope to clear off some of our very heavy arrears.

Cold Storage of Yeast for Transport Abroad

AN INVESTIGATION INTO THE EFFECT OF STORAGE AT DIFFERENT TEMPERATURES ON THE BAKING QUALITIES OF YEAST

By Edmund B. Bennion, M.Sc.Tech., A.I.C.
National Bakery School, London

THE EXPORT of yeast from this country to all parts of the world is an industry which has assumed very considerable importance during the past decade. For this trade the regular trading lines are used, generally the weekly passenger services being preferred so that regularity of delivery is more or less guaranteed all the year round. Yeast is shipped under cold storage to Africa, India, China, America, and many other places frequented by passenger ships. Similar export trade exists from Holland and America. To-day the yeast is stored in refrigerators so that it is carried in a frozen state wherever required, except for a few places where the journey is sufficiently short to enable safe delivery by cool room transit rather than refrigerator storage. While this trade has increased and improved methods of shipment have been devised, complaints about the quality of yeast received have also diminished, largely because of the greatly improved results obtained with such yeast compared with previous varieties available and particularly the home-brewed barms so widely used previously.

There has, however, been no published work on the effect of storage on the general keeping qualities. The present investigation was carried out to determine the effect of cool storage at 40° F. and actual freezing at 28° F. on the behaviour and keeping qualities of yeast. Further, it was designed to show that prolonged storage of yeast in the frozen condition does not destroy the yeast, but merely affects its baking qualities.

Three different varieties of yeast—fast, medium, and slow—were taken for this investigation, so that detailed examination could be made on those properties which are specific to bakers' yeast, particularly gas evolution.

Fermentation tests, baking tests, and microscopic examinations were carried out each week over a period of 13 weeks, the experiment being repeated 4 times and the mean results taken. The figures shown in Tables I and II are the average of three series of experiments. Photographs of the bread produced at various intervals of time were taken.

TABLE I.

CYDINDER TESTS ON YEAST KEPT IN COLD STORAGE.

No. of Weeks in Storage.	*No. 1.*		*No. 2.*		*No. 3.*	
	Max. Ht.	*Time Taken.*	*Max. Ht.*	*Time Taken.*	*Max. Ht.*	*Time Taken.*
FRESH ...	160	1¼ hours	145	1½ hrs.	130	1¾ hours
COLD STORE AT 40° F.						
1 week ...	150	1½ ,,	140	1½ ,,	125	1¾ ,,
2 weeks ...	150	1½ ,,	130	2 ,,	115	2 ,,
3 ,, ...	128	1½ ,,	120	2 ,,	110	2 ,,
4 ,, ...	115	2 ,,	110	2¼ ,,	110	2¼ ,,
5 ,, ...	115	2 ,,	100	2¼ ,,	110	2¼ ,,
6 ,, ...	112	2 ,,	105	2 ,,	100	2 ,,
7 ,, ...	115	2¼ ,,	105	2½ ,,	105	2¼ ,,
12 ,, ...	90	After more than	112	3½ ,,	120	3½ ,,
13 ,, ...	90	9 hours	90	Over 6 ,,	90	6 ,,
FROZEN AT 28° F.						
After 3 weeks	150	2 hours	130	2 hours	125	2¼ ,,
,, 4 ,,	150	2 ,,	125	2½ ,,	115	3 ,,
,, 5 ,,	135	3 ,,	115	3 ,,	112	3¼ ,,
,, 6 ,,	125	2½ ,,	115	3 ,,	110	3¼ ,,
,, 7 ,,	128	3 ,,	112	3¼ ,,	110	3¾ ,,
,, 12 ,,	126	3 ,,	135	4 ,,	130	4¾ ,,
,, 13 ,,	120	3½ ,,	120	3½ ,,	115	6 ,,

FIG. 1.—Loaves made with yeasts which had not undergone cold storage.

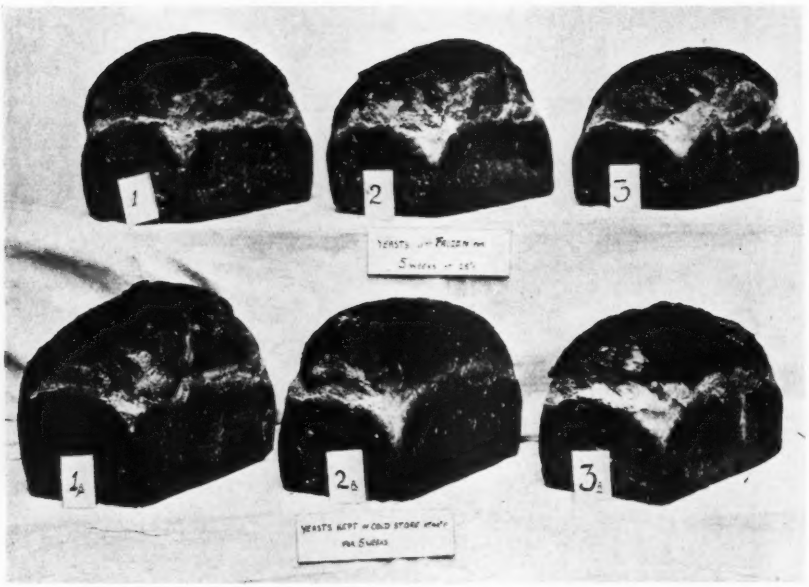


FIG. 2.—This shows, above, loaves made with yeasts frozen for 5 weeks at 28° C., and below, with yeasts kept in cold storage at 40° C. for the same period.

TABLE II.

VOLUMES OF LOAVES PRODUCED FROM YEAST KEPT IN COLD STORAGE.

No. of Weeks in Storage.	*Volume in c.c.*		
	No. 1.	*No.* 2.	*No.* 3.
FRESH	3,100	2,900	2,450
COLD STORE AT 40° F.			
1 week	3,015	2,800	2,360
2 weeks	2,880	2,760	2,490
3 ,, ...	2,770	2,625	2,400
4 ,, ...	3,000	2,580	2,655
5 ,, ...	2,750	2,700	2,540
6 ,, ...	2,850	2,670	2,600
8 ,, ...	2,700	2,650	2,600
13 ,, ...	—	2,400	2,020
15 ,, ...	—	2,350	2,050
FROZEN AT 28° F.			
After 3 weeks	3,020	2,750	2,700
,, 4 ,, ...	2,990	2,750	2,500
,, 5 ,, ...	3,010	2,700	2,370
,, 6 ,, ...	2,950	2,730	2,530
,, 8 ,, ...	2,550	2,600	2,100
,, 13 ,, ...	2,500	2,550	2,010

Storage of Yeast at 40° F.

Consideration of Tables I and II will be necessary in discussing the results obtained. Cold storage of yeast at temperatures above the freezing point can only be regarded as a means of short-period storage—that is, up to about eight weeks.

At such temperatures the yeast is not frozen, and so gradually bio-chemical changes take place which result in a loss of vitality and fermenting power, and ultimately auto-fermentation of the yeast itself. This latter factor will depend, however, on the type and size of refrigerator used, the size of package of yeast stored, and other substances stored in the refrigerator. In the experiments carried out the cabinet refrigerators were employed, but because of the opening and shutting of the doors, temperature variation occurred from time to time which seemed to influence the keeping qualities.

In all cases the yeasts underwent auto-fermentation after a period of 13 weeks. Most probably, under more carefully controlled refrigeration conditions, the time of storage before such changes occurred would be greatly prolonged.

During the storage period a gradual loss of gas-producing power was noted, which was no greater in the case of the fast-working yeast than the slower working variety. In all cases the times taken for the attaining of the maximum volume were comparable.

In the baking tests the gassing diminished in the same way as in the cylinder tests, but the ripening of the doughs proceeded in a normal manner, so that when the doughs were scaled at the ordinary fermentation time they had every appearance of possessing the normal degree of elasticity.

Volume Change with Time

The volume of the finished loaves, however, showed differences not revealed by the cylinder tests.

The fast and medium-slow working yeasts showed a diminution of volume week by week, whilst the slower working yeast showed increases in volume up to a period of eight weeks, then a gradual diminution.

At the end of five weeks the volume of the bread obtained from yeast in cold store at 40° F. could be considered that of ordinary commercial bread, the volumes being of the order expected from the qualities of the yeasts.

After eight weeks it will be noticed that the volume of the loaves is slightly smaller. All these loaves have the "flying top", which might have been corrected by longer proof in the tin. The results were obtained by the standard baking test, so that longer proof could not be given if comparative results were to be obtained. Although gas production was slower in the tins it will be seen that in the oven there was sufficient oven spring to give a loaf of good volume. Further, the quality of the crumb was such as to show that fermentation of the gluten had been satisfactorily carried out, and the crumb itself possessed a moistness and good keeping qualities.

After the eight-week period the volume of the bread gradually diminished, and by the end of thirteen weeks the bread had become distinctly poor, and could in no way be considered commercial, the gassing power of the doughs was poor, the doughs all sagging, the proof in the tins was extremely poor, but the lift in the oven was sufficient to save the appearance of the bread.

With the diminishing volume of the bread, so the bloom and general appearance diminished.

During the period of storage moisture was lost from the yeasts, but the quantity lost depended largely on the type of wrapping material used, and the effectiveness with which this could be sealed. After two months some samples of No. 1 yeast showed signs of auto-fermentation, whilst such signs were not visible in No. 2 until after three months, whilst No. 3 showed no signs until after five months. It is considered, however, that it is the type of packing used which was primarily responsible for these differences, as No. 1 was packed in greaseproof paper, No. 2 in wax paper, and No. 3 in tin foil.

It can be seen from these results that cold storage at 40° F. provides an adequate means of storing yeast so that it can be kept from undergoing auto-fermentation. Even though its gas-producing qualities are impaired, it is still a good fermentation agent for the production of bread.

Storage of Yeast at 28° F.

When the yeast had been in the refrigerator for four days at this temperature the 1-lb. blocks were all frozen throughout. On breaking the blocks of yeast prior to using them, crystals of ice in the mass were distinctly visible. In order to ensure that the yeast was in the most suitable condition for use it became our practice to allow the amount of yeast to be used to stand for two hours at atmospheric temperature in order that it should have a chance of becoming de-frosted. It should here be pointed out that with larger quantities a correspondingly longer period would, of course, be necessary—in many cases up to 12 hours.

With the cylinder tests for gas production and fermentability, the figures in Table I show freezing to be more effective in retaining the gas-producing power of the yeast than cold storage at temperatures above 32° F.

For example, after six weeks No. 1 yeast rose to a height of 112 in the cylinder when used after being stored at 40° F., whilst the height attained after having been frozen was 125. Similarly, No. 2 gave 105 as compared with 115, and No. 3 gave 100 as compared with 110.

After twelve weeks the difference is still more marked, and this is of great importance, since freezing as a means of conserving yeast would entail storage of the yeast over a longer period than storage at normal food storage temperatures around 40° F.

With No. 1 yeast the height in the cylinder after storage at 40° F. was 90, as compared with 126 obtained with the same yeast frozen; with No. 2 the figures were 112 as compared with 135, and with No. 3, 120 as compared with 130.

Against this increase in height attained there is the longer time factor, the average increase of time required being half an hour in the case of the frozen yeasts for the maximum height to be attained.

From the baking tests carried out it will be seen that the effect of freezing the yeast on the volume of the bread obtained is very little different from that obtained from the chilled yeast.

From Fig. 2 it will be seen the volume of the bread was only less in the case of No. 3. No. 1 loaf was actually bolder and bulkier, and possessed a good bloom.

From Fig. 3 it will be seen that the bread produced from the frozen yeast is of smaller volume than that produced from chilled yeast.

From Fig. 4 the difference in volume is very slight, and the outstanding yeast is No. 2, which, after having been frozen for thirteen weeks, actually gave a much better loaf than the same yeast chilled.

The frozen yeasts were kept for a total period of 26 weeks, when the cylinder readings and loaves produced from the baking test were practically the same week by week. Any differences which occurred in the loaves were found to be due more to the manipulative process than the yeast when duplicate bakings were carried out.

Effect of Yeast Storage on Gas Production

Storage of the yeast at 40° F. and at 28° F. was found mainly to impair the gas-producing qualities, whilst the gluten-maturing or dough-ripening qualities were not impaired to anywhere near the same extent.

Freezing of the yeast was found to be the most effective means for the storage of yeast. After eight weeks' storage the effect on gas production became marked.

Instead of vigorous gas production and a well-aerated dough there was obtained little gas production in the dough during fermentation, so that the dough sagged rather than kept a bold appearance, and so possessed little stability. Consequently, yeast which had been stored under such conditions was not suitable for use in cottage bread, for when so used, unless with excep-

FIG. 3.—Loaves made with yeasts kept in cold storage for 8 weeks compared with those in which the yeast was frozen for the same period.

tionally tight doughs, a bold loaf could not be obtained, and with a tight dough the loaf obtained was exceedingly small in volume.

As a result of the observations made during the many baking tests carried out, it seemed evident that the properties possessed by the yeast for bringing about the conditioning or gluten-maturing of the dough were not impaired by freezing, but the gas-production powers were those affected. Therefore, it was considered necessary to use a yeast stimulant which would influence gas production without affecting the conditioning of the dough. For this reason malt was ruled out as a yeast food under such conditions. Nevertheless, a series of experiments were carried out to prove the accuracy of this surmise.

It is often considered that the value of malt in a dough lies in its ability to provide fermentable sugar and diastase capable of producing more sugar from the starch of the flour. Little stress is laid on the value of malt for conditioning the gluten. Actually, the great value of most malt products lies in their ability to condition the gluten through the action of the proteolytic enzymes contained therein. When malts were used with frozen yeasts, non-diastatic as well as low diastatic, the results obtained were similar to one another. The doughs softened to a greater extent than previously, and gas production was not greatly affected. The volume of the bread was slightly greater than when malt was not used, but the crumb was difficult to bake out.

FIG. 4. - A comparison between cold storage and freezing for 13 weeks.

As the enzyme zymase is considered to be the one responsible for gas production, lack of gassing power must be produced by a diminution in the activity of this enzyme.

Gas production is an essential characteristic of all bread-making yeasts, and it is this factor which suffers first under normal storage conditions. Indeed, the quality of a yeast, as well as its freshness, is largely assessed on its ability to produce gas during the baking process. Failure to do this is either due to the yeast being inferior in quality, or not as fresh as usual.

It can easily be understood that storage of yeast at low temperatures is bound to affect this property most seriously, and so, if gas production is to be stimulated, an addition of a substance must be made which will bring about this desired result.

Conclusions

1. Cold storage, particularly below 30° F., provides the best means of storing yeast, and particularly of providing a means of transporting it from place to place, especially to tropical or semi-tropical countries.

2. Freezing of yeast does not injure the structure of the yeast, for on microscopical examination of the yeast cells, all showed signs of perfect formation with a highly refractive protoplasm. Even after being frozen four months there were no dead cells present in any of the samples submitted.

3. Freezing of the yeast reduces the gas-producing power of the yeast. This diminution varies directly with the time of freezing, but after thirteen weeks no further diminution occurred. The diminution with freezing is not so great as when the yeast is kept "chilled" at 40° F., apparently because of other changes—probably auto-fermentation—which are proceeding at the same time.

4. The activity of frozen yeast, as far as gas-producing qualities are concerned, can be increased by the use of sodium phosphate to the extent of 0·5 per cent. on the weight of flour.

5. Freezing seems to provide a means of keeping yeast for long periods—at least six months—as this investigation has shown to be possible.

Chilling, or cold storage, is only really effective for six weeks, although this period can be extended to fourteen weeks if precautions are taken, and lack of gas production is not too serious a consideration.

FACTS ABOUT HONEY

AN interesting and useful little booklet with the above title, written by Herbert Mace, is published by the *Beekeeping Annual* Office, price 2d. post paid.

In it are described varieties of British honey, analysis of honey from various sources, the preparation of comb and extracted honey, and selected recipes are given for honey cakes, sweets, beverages, medicines, ointments, and cosmetics.

* * *

WE draw the attention of readers to a mistake which occurred in our article on jelly manufacture in the December, 1934, issue of this journal. In the paragraph entitled "Grape Jelly" on page 429 (bottom of right-hand column), the temperature quoted as 40° C. in the sixth line of the paragraph should be 40° F.

The Physical Properties of ICE-CREAM

By Eric L. E. Humphriss

THE GENERAL trend of research and investigation into the physical side of ice-cream technology can be summarily described as an effort to explain the behaviour of the mix during processing, and the palatability of the final product, in terms of the physical constants of the mix. It has at once to be admitted that though progress in some directions has been made, the effort on the whole has not as yet been conspicuously successful. In the present article an attempt is made to outline the main physical characteristics of the mix and the state of our knowledge of them.

The first, simplest, and most obvious physical constant of ice-cream is specific gravity. It increases with increase in non-fatty solids content and is inversely related to fat content and to overrun. A mix of fat content 10 per cent. with 24 per cent. non-fatty solids has a specific gravity of approximately 1·10, whilst the same mix whipped and frozen to 100 per cent. overrun would have a specific gravity of 0·55.

Viscosity

Probably the physical constant most frequently referred to is viscosity. The earliest investigations demonstrated that an increase in the fat content of the mix resulted in a corresponding increase in the viscosity. Homogenisation was also shown to have a similar effect. A rather confused association between viscosity of the mix, whipping ability, and smooth texture seems to have become prevalent some years ago, when the then current idea appears to have been that all three were inter-related phenomena varying in the same sense. As carefully documented evidence accumulated the unsoundness of this view became apparent, and culminated in the experimental demonstration by Olsen of the necessity for ageing no longer than 4 to 6 hours prior to freezing. Lucas and Scott have shown that there is no relationship between mix viscosity and melting time of ice-cream, whilst the viscosity-increasing and simultaneous overrun-suppressing effects of fat globule clumping are now universally recognised.

Mix viscosity has been resolved into (*a*) true viscosity, a physical constant showing the normal variation with temperature and exhibiting only a small increase with time, and (*b*) apparent or colloidal viscosity, a function of the colloidal constituents (principally the proteins casein, albumin, and gelatin). Colloidal viscosity increases with time, but is fairly easily destroyed by mechanical agitation, when the mix reverts to the condition where it exhibits a true viscosity. The slight increase in basic viscosity on standing is thought to be due to solidification of fat globules. Leighton and Williams have fairly recently demonstrated that variations in homogenising temperatures affect the basic viscosity of the mix, and also that under restricted experimental conditions a simple inverse relationship between basic viscosity and whipping ability can be recognised. The experimental conditions under which this relationship was found were so far removed from anything that could be called ordinary practice that the statement, that the basic viscosity of a mix is apparently no measure of its whipping ability, is still true.

Plasticity

Leighton and Kurtz have published some work bearing on the relationship between viscosity and plasticity of the mix. By viscosity measurements under different pressures and extrapolating their results to zero flow, they arrive at an evaluation of the plasticity. Kurtz has further obtained some data which suggest that the plasticity of a mix is a measure of the force necessary to break the micelle structure, and further points out that by this means we have a method of measuring gel strength in fundamental units (dynes). He suggests that investigation of gelatin samples along these lines would probably give a truer indication of the value of a gelatin as an ice-cream stabiliser than do the current gel strength tests.

The surface tension of the mix has received attention for some time; Reid and Russell found this to vary from 47·61 to 65·55 dynes per cm., and Gebhardt, as the result of his studies, concluded that increase in fat content caused a decrease in surface tension, whilst homogenisation had the opposite effect. No correlation between surface tension and whipping ability of mixes has been found.

Surface Tension/Adsorption Relations

The close relation between surface tension and adsorption was, of course, demonstrated years ago by Gibbs

and J. J. Thomson as a result of experiments in pure physical chemistry, and closer attention is now being given to the association of those two phenomena in ice-cream research. The possibility of irreversible adsorption of proteins and polar adsorption of lecithin on the fat globules is now recognised, and the effects of such associated phenomena are being studied.

Cohesion in liquids has been demonstrated, though methods whereby the constant can be measured in the ice-cream mix with accuracy have not as yet been developed. Nevertheless, gelatin and serum solids have been indicated as augmenting, whilst fat reduces, the liquid cohesion of the mix. Lucas and Roberts have put forward, and Sommer and Horrall have developed, a theoretical explanation of the whipping properties of mixes based on the mix cohesion. The data are as yet scanty and the conclusions rather hypothetical.

Importance of *p*H

The *p*H of the mix is a constant which, it would be anticipated, would significantly influence many of the physical characteristics previously discussed, but curiously enough little work appears to have been done on this aspect of the subject. The *p*H of an ice-cream mix made from fresh dairy products varies from 6·1 to 6·4, and Dahle, Keith, and McCullogh report a decrease of about 0·05 consequent upon homogenisation. It has been pointed out by Troy and Sharp that since an increase in *p*H accelerates the conversion of β- to α-lactose, such an increase may tend to cause sandiness. The effect of increase in *p*H on proteins in the mix appears to be to give increased stability, although the results obtained on gelatin in terms of the effect on gel strength are rather conflicting.

It remains now only briefly to consider the physical constants of the mix in relation to its freezing. The specific heat of a mix varies with its composition, and the latent heat abstracted during freezing is, of course, that of fusion of ice. Leighton has compared the actual freezing points of mixes at successive stages in condensation with the calculated freezing points based on the ordinary analytical and physical data, and has found good agreement. By plotting freezing points against proportions of water removed as ice he obtained approximations to the actual amount of ice formed in the freezer.

"Critical Points" in Freezing

K. E. Wright, in a paper published four years ago, drew attention to a "critical point" which would appear to be the point on the temperature scale where the maximum number of ice crystal nuclei are formed and which, for optimum smoothness of texture, must be reached in the freezer. For a mix of 12 per cent. fat, 10 per cent. M.S.N.F., 15 per cent. sugar, and 0·35 per cent. gelatin, the temperature coincident with the critical point is given as +25·5° F.

Mention must also be made of cryohydric points in the ice-cream mix, which in all probability have a more important bearing on texture and deterioration thereof than is generally recognised. The most important cryohydric point in ice-cream is probably that of sucrose, which according to Leighton occurs at −12° C.

The lowest cryohydric point in the lactose group is −4·1° C., and hence is probably reached in the freezer and never again approached until the ice-cream is consumed. That of sucrose, however, is in the vicinity of temperatures not infrequently reached in "warm" hardening rooms, and may easily be exceeded unless care is taken during packing and distribution. Should such conditions obtain prior to the cream being subsequently rehardened, significant texture deterioration due to ice crystal growth is readily understandable.

Finally, the suggestion may perhaps be allowed that although the physical aspect of ice-cream technology is familiar to research workers, it does not always receive the attention it merits from practical ice-cream makers.

New Wheat Laboratory

THIS picture gives a view of the specially designed dough testing laboratory at Dover. In it are tested doughs which have been made from flour prepared in a special laboratory and ground under standardised conditions. These laboratories are kept at constant temperature and humidity. Plates of dough of standard size are cut out, and these are tested for gluten strength in the Chopin Extensimeter shown on the left, against the window.

On the right, below and slightly to the left of the hanging lamp, is the Brabender Farinograph, which gives additional information relating to gluten development, and further to the right the tallest instrument is the Brabender Fermentograph, by means of which the fermentation characteristics of the prepared doughs are investigated.

ICE-CREAM STANDARDS

WE WERE glad to have the opportunity of being present at a most interesting and lively discussion on ice-cream recently. The occasion was a Sessional Meeting of The Royal Sanitary Institute, London, and the subject was "Bacteriological and other Standards for Ice-Cream". The chair was taken by Dr. Thomas Orr, and the discussion was opened by Dr. L. H. Lampitt, Chief Chemist of Messrs. Lyons, and Mr. E. B. Anderson, Chief Chemist of United Dairies.

DR. ORR, in introducing the subject of the discussion and the speakers, said that ice-cream was a food of great value. There had been very considerable improvements in methods of manufacture in the last few years, but even to-day very varied methods are employed and very varied products encountered.

DR. LAMPITT, opening his contribution to the discussion, said that all the possible standards which might be applied to ice-cream might be divided into two broad classes, bacteriological standards and other standards. He proposed to deal with the other standards, though he did say that it seemed to him to be unreasonable to ask for bacteriological standards for ice-cream when there was none for the milk used as a raw material.

The imposition of standards of any sort, he continued, might be justified by one or more of three considerations:

(1) Economic;
(2) Hygienic and/or food value;
(3) Commercial.

The states in the great butter belt of North America demand a high butter value.

Composition of Ice-Cream

Ice-cream, said Dr. Lampitt, is milk or cream with sugar, suitably flavoured and frozen. Colouring matter and a stabiliser are generally added. The stabiliser is often gelatin, and this is very important in influencing the physical properties of the finished article. He had heard this gelatin addition spoken of as though it were something in the nature of a filler, but this, of course, was ridiculous as it rarely exceeded in amount one-half of 1 per cent. of the total.

"*I hold most definitely*", said Dr. Lampitt, "that products with a base of cornflour should be excluded from the range of products considered by the definition 'ice-cream'. Likewise with products in which butter is replaced by other fats."

Palatability

As regards the food value of the product, the consideration of palatability is inseparable from this. A high fat content is cloying on the palate, and people are very easily satisfied with a very rich product.

Cream itself is not suitable for making commercial ice-cream. The amount of solids-not-fat is to a certain extent subject to manufacturing control. Sandiness often results if the solids-not-fat exceed about 10 per cent.

The mechanisation of ice-cream manufacture has introduced many modifications, but it has enabled some kind of bacterial control to become possible.

Ice-cream of the vanilla type is coloured, not to make it resemble cream, but to give something pleasing to the eye.

Uniform flavour, colour, and texture are essential to success in food manufacture, and added flavour, added colour and stabilisers are necessary in some cases to obtain these conditions with ice-cream.

"I have heard a lot of nonsense talked about 'over-run'", said Dr. Lampitt. This is quite a straightforward matter, and is the excess in volume of the ice-cream over the volume of the mix, and is due to the incorporation of air during freezing. The presence of this air is most important for palatability. Standards of "over-run" do not vary very much from firm to firm.

Schemes of Standardisation

Complete specifications for ice-cream are in force in Canada, Australia, Tasmania, Switzerland, and many other countries, and a very complex scheme of regulations has been set up in Shanghai. The U.S. Federal standard of 1906, which specified a minimum of 14 per cent. of butter fat, was not observed, and it was rescinded in 1930 because it was not satisfactory.

The standards of Tasmania are typical of many: they lay it down that ice-cream shall consist of milk and cream or their products, with sugar, with or without fresh eggs, flavoured with fruit or nuts, coloured or not with harmless colouring substances. It must contain not less than 10 parts per 100 of milk fat in the form of cream, and the addition of more than 1 per cent. of thickening substances is prohibited. No person is allowed to refill a once-used package made of cardboard, wood-pulp, or other absorbent material. Ice-cream may not be described by the name of any fruit unless this fruit is actually present, an exception being made when the name is coupled with the word "artificial".

In conclusion, Dr. Lampitt said that his remarks had been offered in the hope of stimulating discussion.

MR. ANDERSON said he proposed to discuss the subject from the bacteriological standpoint. Ice-cream is essentially a milk product, and there are four points to be considered:

(1) What pathogenic organisms are likely to be present?

(2) Has ice-cream been the cause of disease?

(3) Whether standards would improve this;
(4) If so, what standards?

The pathogenic organisms likely to be present are those characteristic of milk and those carried by milk.

Outbreaks Traced to Ice-Cream

In regard to outbreaks of disease which have been traced to ice-cream, the fullest information is available from the United States, because the people of the U.S.A. are the biggest consumers. In the period 1908-1927 ice-cream was incriminated in 37 outbreaks of disease in America. In this country there had been only two outbreaks, both in 1925. At Aberdeen, 23 cases of paratyphoid B were traced to a carrier, and 24 cases of dysentery at Worcester were said to have been caused by ice-cream, though the circumstances of this latter outbreak were obscure.

In some cases infection was carried in from the raw milk, in others it occurred during manufacture. "Personally", said Mr. Anderson, "I doubt whether bacteriological standards alone can prevent outbreaks of disease." As well as being made in modern, well-equipped factories, ice-cream is made in small shops and other places where processing, if done at all, is very haphazard.

This is where infection can arise. Among small makers cold mixers are becoming popular; if good quality raw milk or cream is used these are quite satisfactory, but if the milk is wrong the ice-cream is quite certain to be wrong if there has been no resort to heating. Freezing and hardening at low temperatures are no safeguard, for hæmolytic bacteria have remained alive after 18 days under such conditions. Other bacteria have remained alive for 2 years and 4 months in ice-cream.

Some Important Considerations Suggested

Mr. Anderson suggested four "cardinal points" for ice-cream:

(1) All makers and sellers of ice-cream should be registered.

(2) All ice-cream mixed should be pasteurised at not less than 145° F. for 30 minutes.

(3) A high standard of cleanliness should be maintained.

(4) Regular medical inspection of works should be established.

If these conditions were accepted, bacteriological standards would be useful to check pasteurisation.

"I agree with Dr. Lampitt", said the speaker, "that we are putting the cart before the horse in talking about bacteriological standards for ice-cream when we have none for milk."

Significance of Bacterial Count

Maximum figures for total bacterial count tolerated by different countries vary most widely, he continued. In fact, figures varying from 5,000 to 500,000 per c.c. have been specified by different countries. There is no general consensus of opinion as to whether the gross count has any significance.

It is noteworthy that three countries demand that *no pathological organisms at all* shall be present. Moreover, many *B. coli* strains can withstand pasteurisation for 30 minutes at 145° F., while some can even withstand 150° F. for this period of time. Bacteriological standards should only be considered in relation to the other three points enumerated above.

Concluding, Mr. Anderson said that he, too, offered his remarks as a basis for discussion, and Dr. Orr accordingly declared the meeting open.

Registration of Doubtful Value

Dr. Vynne Borland, Medical Officer of Health for Bethnal Green, said that compulsory registration had not had much effect on the number of notices which had had to be served. He described cases where very high bacterial counts had been traced to butter, but widely varying results had been obtained on the same sample from different bacteriological laboratories. He concluded that registration was no good, that a high standard of cleanliness should be enforced, and that it was much better to insist on pasteurisation of the ice-cream mix than of the milk.

Mr. T. Benson, Chairman of the Public Health Committee and late Food Inspector of Littlehampton, said: "With regard to chemical standards, I think these are very necessary. The Ice-cream Manufacturers' Association want a standard. I think bacteriological standards are also necessary, but I agree that we are putting the cart before the horse in applying them to the ice-cream and not to the milk.

"We have got to have standards for milk.

"All premises should be registered, and there should be medical inspection of the people employed on the premises."

Hygienic Standards

Mr. Walters, Food Inspector of Kensington, said: "We want chemical and bacteriological standards, but hygienic standards are also very necessary. It is in the smaller concerns that trouble arises. The same legislation that is applied to milk should be applied to ice-cream."

Mr. P. Coombs, President of the Ice-cream Association, said that his Association was pushing for a chemical standard. "We agree", he said, "that it is better to apply bacteriological standards to milk and cream than to the ice-cream. Hardship would be inflicted on the small men if we put the standard on the finished article."

A Test for Pasteurisation

Professor H. D. Kay, of the National Institute for Dairy Research, Reading, said he would like to insist on a chemical standard for ice-cream. "*There is a test*", he went on, "*which can be applied to milk, butter, or cream to see whether pasteurisation has been properly carried out.* This is an enzymic test."

Mr. Edward Kilner caused quite a stir when he announced himself as the late Sanitary Inspector of Shanghai, and we gathered from the expressions on their faces that Dr. Lampitt and Mr. Anderson had not expected their remarks about conditions in Shanghai to be brought home to them in this fashion. Mr. Kilner said that they had heard a lot about Shanghai, and as he was responsible for many of the regulations in force out there he thought he ought to say something about them.

No Selling in the Streets!

First of all, it was not so much a matter of standardisation as a scheme of classification which had been adopted, and a certain number of regulations had been devised and were strictly enforced. A product had to be bacteriologically examined before a licence was granted to manufacturers in Shanghai, and the possession of the licence was necessary to legalise sales. No ice-cream was sold in the streets of Shanghai.

Bacterial "Clumping" a Difficulty

MR. FRED J. ORTH next made a characteristically vigorous contribution to the discussion. He said that it was impossible to make accurate bacterial counts on account of bacterial "clumping". It was therefore not fair to ice-cream manufacturers to impose bacteriological standards until this could be remedied.

"I think cornflour is quite permissible in ice-creams provided the minimum fat content is observed", he said, and added: "As regards colour, if you can't get the Devonshire cream colour it is better to leave it out altogether." In conclusion, he said that many outbreaks of disease had been proved to be due to the raw materials, and he could not support bacteriological standards until these were applied to the raw materials.

MR. POWLING said we should do all we could to advocate butter fat and bacteriological standards. "It seems to be the old game of 'passing the buck' as far as the raw material is concerned", he added, amid laughter. "But *we* are selling the ice-cream!" He claimed that the onus was on the manufacturer to produce a pure and wholesome article.

Analyst's Low Fat Values

MR. THOMAS MCLACHLAN, Public Analyst for Westminster, said that in his capacity as public analyst he had found butter fat contents of different samples of ice-cream varying from 1·5 per cent. to 14 per cent. He offered the suggestion that standards set for "ice-cream" might be relaxed somewhat for a cheaper product to be called "ices".

MR. BEN DAVIS said that some of the vanilla essences incorporated in ice-cream are very objectionable. "You buy an ice-cream, and you've got it with you for four hours", he said.

No distinctions are applied to the various bacteria, good, bad, and indifferent; some are actually beneficial and some even are necessary. Total counts are very misleading.

Call for Clean Milk

It is very necessary to get right back to the raw material. He said we should go to the Ministry of Health, and above all to the Ministry of Agriculture, to put *all* milk on a sound, clean basis. This should be done, not for less than 1 per cent. of the country's milk, but for all of it, and not because we were paying more for it.

DR. ORR, in winding up the discussion, said that it seemed clear to him that all premises should be registered, together with all persons engaged in the manufacture of ice-cream. We don't know enough about bacteriology to impose a standard, but we can impose a standard on the materials and processes of manufacture. He then called upon Dr. Lampitt and Mr. Anderson to reply to the discussion.

DR. LAMPITT said: "When I analyse an ice-cream and find 25 per cent. of starch, I begin to question the validity of its name." A great many ices are flavoured with coumarin; this has no resemblance to vanilla and never saw the inside of a pod. Now this is one of the flavours which last four hours, but many of the public like flavours which last much longer than this if they can get them.

Interpreting Bacterial Counts

MR. ANDERSON said a great deal of latitude must be allowed in interpreting the results of bacterial counts; 80,000 or 100,000 bacteria to the c.c. means the same thing, and these figures must always be interpreted very carefully.

"Clumping" occurs in all bacterial growths, and it cannot be eliminated without very careful standardisation of conditions. It is necessary even to standardise the shaking and the distance through which the bottle is moved during shaking.

MR. CRESSWELL, Chairman of the Council of the Royal Sanitary Institute, in closing the meeting and thanking the speakers, said that, speaking as a layman, it seemed clear to him that legislation was necessary, but that liability would never be put on the producer of the milk.

Preserving Orange Juice (Continued from page 88.)

during one day and held in storage for delivery the following morning, and if on delivery the juice was transferred to a refrigerator of the ordinary type, it would have a holding capacity of two or three days without danger of either spoilage or the development of tastes which would distinguish it from fresh juice. This type of distribution used in connection with restaurants, hotels, and sweet shops would offer several advantages over the present practice. It would eliminate the extraction of the juice in the retail establishment, with its attendant inconvenience and litter: it would ensure the consumer of a uniformly high-grade product of known quality produced by the best methods; it would offer a sufficient period for disposal before deterioration, thus eliminating losses due to spoilage—and it would, by familiarising people with orange juice in a bottle, open the way to a future delivery to the doorstep.

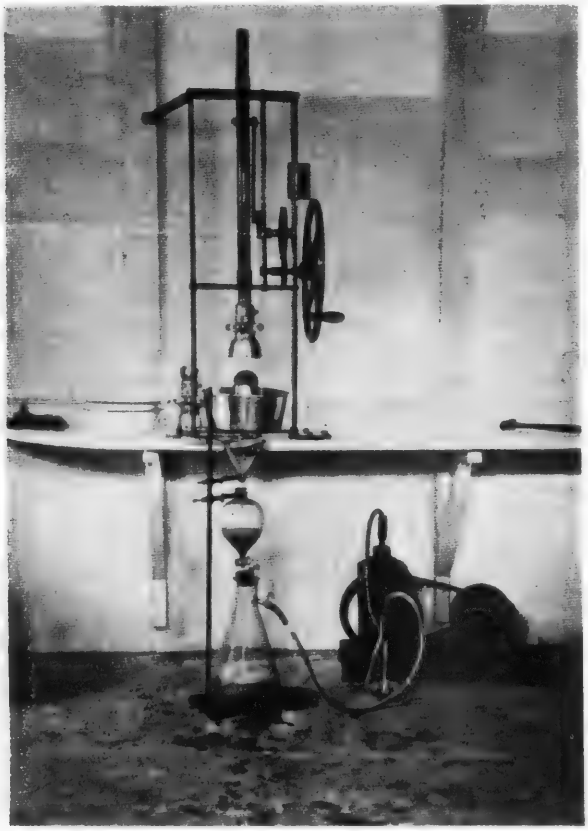
In commenting on the above, it is well to call attention to the fact that the orange juice very commonly merchandised in restaurants and hotels, even in citrus growing areas, is not all that it should be. It may be bitter if held over night, or full of oil if certain methods of extraction are used. The writers have ordered orange juice in a large number of restaurants and hotels in this and other states and have yet to find a juice served that would equal in taste and quality a juice that could be put out under the methods outlined here. This opinion has been borne out by the results of a trial in a restaurant and discussion with restaurant and sweet shop proprietors.

PRESERVING ORANGE JUICE

By A. E. Camp and A. L. Stahl

Agricultural Experiment Station of Florida

THE FOLLOWING is an account of the latest progress which has been made in Florida in the attempt to find a satisfactory commercial method for the preservation of orange juice. There have been many attempts in previous years to apply various methods of heat treatment and freezing, but they have not been entirely successful owing to the extremely sensitive and fugitive nature of the fresh juice flavour which it is necessary to preserve in any product acceptable to the public. During the past few years, however, Mottem, von Loesecke, and Pulley at the U.S. Citrus Products Station, Bureau of Chemistry and Soils, Winter Haven, Florida, and Camp and Stahl at the University of Florida Agricultural Experiment Station, Gainesville, have turned their attention to other methods in which the principle of removing air from the juice, immediately it is pressed out of the fruit, forms an essential feature. The following account (abstracted from *Fruit Products Journal*, August, 1934) of the work carried out by Camp and Stahl is of very great interest.



Experimental cup-type press taking halved, unpeeled fruit.

History

The canning of orange juice appeared from the first to offer the natural solution of the problem, but so far canning has not met the situation satisfactorily, as judged by the size of the commercial pack of orange juice, and this is undoubtedly a reflection of the market demand for the product.

The freezing of orange juice was attempted on an extended commercial scale in 1931 by two companies in Florida. These operations lasted only the one season, the work being abandoned before the beginning of the following fruit season. The reasons for this were various. Part of the trouble lay in the development of off-taste in the frozen juice, which made it an undesirable article for market, and partly in the problem of marketing the product, much of this hinging around the question of thawing or "defrosting". These factors, together with the question of cost to the consumer, proved to be too difficult to surmount at the time.

The milk distributing companies were at that time the parties most interested in the question of frozen orange juice. The basic idea involved the distribution of the frozen juice with the morning milk. Since orange juice is widely used at the breakfast table, this still appears to be a sound idea providing a suitable product can be delivered at a reasonable price. However, the following basic principles must be laid down: The product must be the approximate equivalent of fresh juice in taste and quality, and contain no added materials (preservatives or sugar). It must be easier and quicker to prepare it for the table than to extract juice from whole oranges, and finally the cost to the consumer must be reasonable.

While working on the problems involved in freezing orange juice, such success was attained in the preservation of properly extracted juice in cold storage, but without freezing, that it was decided to study the commercial possibilities that might be involved. It was hoped that methods could be worked out whereby the juice could be handled along with milk and subject to no more difficulties and hazards than now attend the distribution of milk to the consumer. The results of this work have been very gratifying and the methods should be capable of considerable commercial development since the product is the equivalent of fresh juice in taste and character, no preservatives being added, and it is as convenient to serve as milk.

Literature

The basis for the present work is provided by the researches of Camp, Traub, Gaddum, and Stahl some three or four years ago and more recently confirmed by Joslyn and Marsh of California. They found that the bitter taste developing commonly in orange juice after extraction is due to some material, probably of a glucosidal nature, leached out of the suspended particles of albedo (white pith) and locular wall tissues. Joslyn suggested that oxidation plays an important part. When juice is extracted from the juice sacs only by dissecting and pressing them, the bitter taste does not develop and a good flavour is retained almost indefinitely on storage at round about 32° F. The closer a commercial method of extraction approaches this method the less the bitter taste develops on standing. If the segment walls and albedo are torn up, leaving particles in the juice, bitter taste develops rapidly. This applies particularly to high-speed reamers and certain presses. Also, the extent of this taste varies with the variety and particularly with the stage of maturity of the fruit. It was found that juice from under-ripe fruit became very bitter on standing and that tangerines, Navel oranges (grown in Florida), and Satsumas were particularly bad in this respect. On the other hand, fully matured fruit allowed a wider latitude in the method of extraction.

Experimental Procedure

In the present work, only sound fruit from the grove of the Experiment Station was used. Generally, the fruit was washed and precooled to 32° F. before juice extraction. A sterilising agent would probably be desirable in washing in commercial practice.

Four methods of extraction were used, each giving certain definite peculiarities. These were (1) a high-speed reamer used on halved fruit; (2) a cup-type press using halved, unpeeled fruit (see illustration); (3) a cup-type press as in Process 2, but used with peeled, halved fruit; and (4) a worm-type press using peeled fruit.

The juice ran from the extractor through a strainer into a separating funnel connected to a flask maintained under vacuum (see illustration). The spraying thus produced assisted removal of air. The apparatus was modified for ordinary bottling or in a gas. The bottles and caps were sterilised and cooled before use. The extraction apparatus was also sterilised between runs and the hands of the operators were kept thoroughly clean. Juice sampling was carried out at 24-hour periods. Sometimes 110 tasters were employed.

EXPERIMENTAL RESULTS

Effects of Methods of Extraction

Bitterness.—The effect of the method of extraction on the development of the bitter taste has been discussed in detail in a previous paper and the work here has confirmed the previous results. When under-ripe fruit was used a pronounced bitter taste developed with those methods of extraction which included particles of the segment walls and albedo with the juice. When fully mature fruit was used this was less noticeable, but with juice extracted by the reamer method some bitterness developed after a holding period of two to four days, depending on temperature. The cup-type press used on peeled fruit was slightly superior to the worm type, though when freshly extracted juice was tested the juice from the latter method of extraction was preferred by a slight majority, probably due to the fact that most people are used to having a considerable amount of suspended material in the juice. On juice stored more than two or three days the preference was for the juice from the cup-type press. In making these comparisons it was necessary to eliminate the juice from unpeeled fruit extracted on the cup-type press due to the coverage of other flavours by the orange oil present in the juice. Juice extracted from peeled, mature fruit on the cup-type press kept at 32° F. for one week or more without material change, while at 42° and 48° F. some deterioration in quality was noticeable after three days.

Terpenous Flavours.—In studying the methods of extraction the question of oil content played an important part, much more so than was the case with studies on frozen juice where changes in chemical composition were greatly retarded by freezing. The cup-type press when used on unpeeled fruit yields a juice having a marked amount of oily rind extract. In cool-stored juice this resulted in the development of a marked terpenous flavour in two or three days. This is probably as much the result of the inclusion of other materials from the rind with the oil as from the oil itself. The results of the work showed clearly that such inclusions caused the development of tastes that would cause the juice to be unsaleable after two or three days. The general assumption of many workers has been that the inclusion of the oil was necessary to give a typical orange flavour and in order to settle the question of preference a tasting test was given to 110 people not connected with the research work. The juices tested had received various gas treatments, all duplicated on practically oil-free juice and juice with a small amount of oil. Eighty-six preferred the oil-free juice, 18 the juice having a slight amount of oil, and 6 were inconsistent in their opinions, a distinct majority in favour of oil-free juice.

Deaeration and Gas Treatment

While deaerated juice has shown somewhat better keeping quality than has untreated juice, this effect has not been found as important as is usually supposed. The effect of removing the air from the juice was sufficient, however, to justify this as a standard practice, and experiments were carried out in which deaerating without gas treatment was compared with treatments with carbon dioxide and nitrogen following deaeration. The gas treatments gave slightly better keeping quality than deaeration alone, though the difference was not great. In some experiments the use of nitrogen gave a slightly musty flavour to the juice after two to four days' storage and was generally considered by the better qualified tasters as inferior to carbon dioxide treated juice. This musty flavour may have been due to impurities in the nitrogen as suggested by Joslyn (1934), as, in all the experiments, nitrogen was used directly from the cylinder. Carbon dioxide had the advantage of covering up slightly

the off-tastes that might develop, this being particularly true of juices containing slight amounts of oil and tending to develop the typical terpenous flavour. Tests in which the nitrogen and carbon dioxide treatments were compared by submission to a large number of tasters showed about an equal division of opinion, all of these tests being carried on with juice free from oily rind extract. It was feared that the slight though almost imperceptible carbonation might be disliked, but in a series of tests in which 110 people were used 58 showed a preference for the carbon dioxide treated juice, 22 preferred the untreated, and 30 were inconsistent or indifferent in their opinions. These tests were run after a 72-hours' storage period and were duplicated with juice containing a slight amount of oil, with almost duplicate results. As a result we would be inclined to favour the use of carbon dioxide over nitrogen though the margin of difference is not great.

Micro-organism Studies

In the earlier experiments some difficulty was experienced with fermentation at the higher temperatures due to yeast, and a sliminess at the lower temperature due to bacterial action. In these experiments none of the utensils had been sterilised and no particular precautions had been taken. A few studies showed very high initial micro-organism counts, but with storage at 32° F. there was a steady downward trend in the counts during the 7-day observation period. At 42° F. the trend was downward for 72 hours and then slowly upward; at 48° F. there was a slow rise within very reasonable limits for 72 hours and then a rapid rise, and at 54° F. the rapid rise started after 48 hours. The juice studied in these experiments was not gas treated, but in a supplementary experiment in which the initial counts were very high, very slightly carbonated juice showed a pronounced decrease in the counts for the 7-day interval, even at 48° F.

In a set of succeeding experiments the precautions reported under sanitation were practised and the initial counts fell to extremely low figures, never being above 1,000 per c.c. In these, as in earlier experiments, there was a downward trend in counts over a one-week period at both 32° and 37° F. (Table I), and a few extra bottles of juice left in storage for several weeks at these temperatures showed no later rise in micro-organism counts. As far as the development of micro-organisms is concerned, a temperature of 32° F. apparently ensures against increases for indefinite periods, whereas temperatures between 40° and 50° F. hold micro-organism development within reasonable limits for at least 72 hours.

Effect of Storage Temperatures in General

The effect of the storage temperature has been touched on in all of the preceding sections. It is obvious that the lower the temperature down to the point where the juice will freeze, the better the holding capacity of the product. With proper fruit, methods of extraction and sanitation, juices have been held for weeks at 32° F. without the development of tastes that would sharply distinguish them from fresh juice and with actual reductions in the micro-organism counts. Almost as good results were obtained at 37° F., but at 42° F. the life of the juice was greatly curtailed though the keeping quality was still superior to that of milk at the same temperatures. At still higher temperatures the life of the product was further reduced. In general, it may be said that, for temperatures below 50° F., 72 hours can be considered a safe period of storage and handling.

Discussion

In accordance with the above, a milk distributing company in a large city could establish a juice extraction and processing plant operating according to the best principles and market fresh orange juice that would be highly acceptable to the public. The juice could be prepared

(*Continued on page* 85.)

TABLE I.

TYPICAL MICRO-ORGANISM COUNTS ON STORED ORANGE JUICE.

			Start.	24 *hours.*	48 *hours.*	72 *hours.*	96 *hours.*	120 *hours.*	144 *hours.*	1 *week.*
Vacuumised, no gas treatment	32° F.	Fungi	0	0	0	0	100	0	0	50
		Bact.*	300	150	500	2,800	150	300	100	0
	37° F.	Fungi	0	0	0	0	0	0	0	0
		Bact.	300	400	750	1,000	1,500	500	50	400
	Room Temp.	Fungi	0	0	500	0	0	0	—	—
		Bact.	300	250,000	150,000	200,000	6,000,000	0,000,000		—
Vacuumised plus CO_2 treatment	32° F.	Fungi	0	0	0	0	0	0	0	0
		Bact.	550	1,500	5,100	250	200	200	50	50
	37° F.	Fungi	0	0	0	0	0	0	0	0
		Bact.	550	3,000	3,500	3,000	1,000	150	100	300
	Room Temp.	Fungi	0	0	0	100	5,000	0	—	—
		Bact.	550	5,000	200,000	550,000	6,000	5,000	—	—
Vacuumised plus N_2 treatment	32° F.	Fungi	0	0	0	100	0	50	0	0
		Bact.	300	6,500	50	600	2,000	200	50	0
	37° F.	Fungi	0	0	0	0	0	0	0	0
		Bact.	300	400	4,000	5,000	1,500	1,000	250	100
	Room Temp.	Fungi	0	0	0	0	0	0	—	—
		Bact.	300	80,000	175,000	750,000	5,000	1,000,000	—	—

* This includes both bacteria and yeasts. At the lower temperatures most of the organisms were bacteria, but the large counts at the higher temperatures consisted mostly of yeasts.

THE TRAINING OF THE FOOD TECHNOLOGIST

We give the first part of Dr. Cronshaw's paper which was presented to the Food Group of the Society of Chemical Industry at the London School of Hygiene and Tropical Medicine on February 13.

The author's views are largely based on his experience as a University Professor, and, later, as Principal of a Technical Institute where he built up successful courses of instruction for the local meat packing industry. Added to this is the experience gained in industry and as Editor of FOOD MANUFACTURE.

By

H. B. Cronshaw, B.A., Ph.D., A.I.C.

THE OBJECT of this paper is to call attention to the lack of any facilities for obtaining organised instruction in the scientific principles of food technology, either at the Universities or at other institutions of similar standing.

Recent enquiries for any such instruction at thirty University colleges and twenty-eight technical institutes have given negative results. The nearest approach to the ideal in view is the course in Foodstuffs in the Department of Applied Chemistry at the Manchester College of Technology. Similar enquiries have been made abroad—in America and Germany, for example.

It is hoped that in this paper a strong case will be made out for the desirability of establishing a post-graduate or similar department of food technology at one or more of the centres of higher education on lines resembling those which have been found successful in the case of other departments of technology, such as fuel, metallurgy, mining, petroleum, glass, and pottery.

The main function of such a department would be to provide post-graduate courses in the technology of foodstuffs, open to students who have attained the degree standard in the basic sciences of chemistry and biology. Too much stress cannot be laid on the necessity for a thoroughly sound training in the basic sciences before the student proceeds to a post-graduate course.

An additional function of such a centre might be to provide facilities for carrying out research work.

Essentially, food technology, in the broad sense of the term, is regarded as a branch of applied biochemistry, and is therefore founded upon the basic sciences of chemistry and biology. The former includes an advanced knowledge, up to degree standard, of physical and organic chemistry, as well as biochemistry itself, while the latter embraces the principles of general biology (and, in some cases, a specialised knowledge of either botany or zoology) together with a good training in bacteriology and mycology.

The post-graduate syllabus is one over which there is likely to be some difference of opinion. The view taken here is that it might embrace the following:

Outlines of food manufacture.
Scientific principles of food preservation.
Scientific principles of baking and confectionery.
Food analysis.
Industrial hygiene, public health, and nutrition.

The second and third subjects noted above are intended to include a scientific study of the principles of process operations such as size reduction, mixing, evaporation, drying, sterilisation, heat transfer, pickling, curing, preservation by cold and by gas storage, and so on. This would necessitate a laboratory equipped with representative pieces of plant to enable the student to carry out experimental work.

The post-graduate course would also have to include biochemistry and general bacteriology if the pre-graduate syllabus makes no provision for these subjects. It is very desirable that the student should spend some time in a works engaged upon the manufacture of a wide range of products, and it is a good plan to arrange for special lectures to be given by representatives of the industry and by members of research stations at intervals throughout the session.

It is considered that some such scheme of training as outlined above is required to meet modern conditions in the food industry. Hitherto the industry has been largely provided with more or less pure chemists; but chemistry represents only a part of the food technologist's requirements.

Thus the general aim is to equip the student with a broad basis of scientific knowledge (not chemistry alone) and also to provide him with a background of experience in the application of this basic knowledge to the process operations employed in the preservation and manufacture of foodstuffs. In addition it is necessary to give instruction in the general technique of the food laboratory and to acquaint him with the structure of the industry and its relations to agriculture, the public health, the nation's food supply, and other relevant matters.

So equipped, the student should be in a fit condition to take up a position in any branch of the industry which happens to present itself. His general training in basic principles will enable him to become quickly adjusted to practical conditions and will provide a solid foundation for subsequent specialisation. Furthermore, the work of the research stations will not lie beyond the range of his intelligence and he will thus serve as the most important means of rendering the results of this work available to industry.

The Food Technologist

In spite of its ugly sound, the term "technologist" is probably the best available label for one who is qualified to apply science to industry. It signifies the triple nature of his attainments; he must know his science and his industry, and he must be skilled in the art of applying the former to the benefit of the latter. It also serves to differentiate him from specialists such

as chemists, bacteriologists, entomologists, chemical engineers, and so forth. The technologist is a specialist in a branch of industry, but not necessarily in any one branch of science. His training must be on a sufficiently broad basis to enable him to utilise the data and the methods peculiar to several departments of science, and, if necessary, to co-operate in an intelligent manner with specialists.

Hitherto the mistake has been made of regarding the term "food chemist" as synonymous with that of "food technologist". The two should not be confused, since food technology embraces not chemistry alone but also biology and bacteriology as essential basic subjects. Most of those who have entered the industry have been chemists pure and simple, and they have subsequently had to patch up their deficiencies on the biological side in a hurried and totally inadequate fashion. Obviously all this should have been foreseen and provided for in order to avoid loss of valuable time and misdirected effort at the most critical stage of a man's career. Such a state of affairs indicates a serious defect in our system of technological training, and one that is highly detrimental to the industry, the research stations, and the individual concerned. It also indicates lack of appreciation of the position which the technologist occupies, or should occupy, in the food industry.

The true conception of the food technologist is that of one who plays an essential and important rôle in the work of feeding the nation. His sphere of influence merely begins at the laboratory bench; actually it extends even beyond the factory, on one side to the farmer and on the other to the public which consumes his products. First and foremost he is the pivot on which the whole organisation of production turns. He is responsible above all for the quality of the products which enter the factory and pass out of it to the consumer—responsible, therefore, not only to the manufacturer but also to the community. One should keep in mind the fact that he is producing, not bricks or iron, but something which is meant for food and upon which the health and welfare of innumerable people are largely dependent. One defective product may wreck his career and may bring his firm to the verge of ruin. On the other side is the farmer who supplies the raw materials for the factory. The technologist is deeply interested in these materials—in their quality and consequently in the manner in which they are produced on the land. This adds another responsibility and imposes upon him the necessity for intelligent co-operation with agricultural pursuits.

There are other directions, too, in which his intelligent co-operation is frequently required as, for instance, with the engineer, the public health officials, the advertising man, the costing clerk, and, in some cases, with the medical practitioner. His interests range over broad questions of national diet and nutrition, food publicity and labelling, standardisation and regulations, factory hygiene and layout, storage and transport, and many others. Of course, he may, either from deliberate choice or by force of circumstances, become a specialist for a part or the whole of his life, possibly in bacteriology, food analysis, plant breeding, or some department of pure or applied research, but this will not obviate the necessity for the broad, technological background which can only be acquired by some such system of training as is advocated in this paper.

It cannot be too strongly emphasised that the technologist is primarily concerned with the *quality* of preserved and manufactured foodstuffs. He watches and controls each step in the chain of operations from farmer to consumer. His methods are those of chemical analysis, physical tests, bacteriological tests, and biological assays, and the laboratory is thus at the centre of his operations. He has to satisfy the health officials that his products contain nothing of a detrimental nature, and, at the same time, the public expects them to be attractive in flavour, colour, and "eating qualities", and, in these relatively enlightened days, to possess vitamins, mineral salts, and other special virtues. In the case of infant foods, "diabetic" foods, breakfast foods, etc., the nutritional aspect becomes increasingly important.

Moreover, he is almost certain to be well occupied in developing new products, in improving old ones, in testing and trying out flavours, colours, and a variety of other materials, including wrapping materials, containers, adhesives, and so forth, as well as in keeping abreast of the enormous output of scientific and technical literature. In some instances the technologist may be called upon to supervise feeding experiments on, for example, pigs intended for bacon curing, or to participate in plant or animal breeding experiments with the object of modifying the product in accordance with factory requirements. Then, again, there is frequently the question of insect pests, moulds, and other destructive agents in both field and factory to be considered, involving, possibly, the fumigation of a flour mill or a storage place for fruit, cocoa beans, or some other material.

Finally, mention may be made of other duties which certainly come within his province, such as those of ensuring hygienic conditions in the factory and of dealing with waste products, both of which are essentially bacteriological problems. There is always the possibility of converting waste into valuable by-products as happened in the early days of meat packing, giving rise to the saying that "the chemist entered the meat packing plant through the back door".

It is obvious, therefore, that if the food technologist is to discharge this multiplicity of duties so as to bring credit upon himself and upon the industry which he serves, he must not only have a knowledge of the basic sciences involved—namely, biochemistry, biology, and bacteriology—but the standard of this knowledge must be a high one; it must, in fact, be such as can only be reached at the university or equivalent institutions. As the matter stands at present, anyone may call himself a food technologist, and the industry will probably accept him at his own valuation, which may or may not be justified by results. The industry is at present forced to take the risk and to apply the haphazard, and possibly costly, method of trial and error. There is no standard and there is no measure of proficiency. It is therefore in the interests of the industry that such a standard should be provided and this is best done by prescribing a suitable course of training.

(*To be continued.*)

VIEWS on TRAINING the FOOD TECHNOLOGIST

The following is a summary of the various opinions which have been expressed by correspondence and during the discussion which followed the presentation of Dr. H. B. Cronshaw's paper to the Food Group of the Society of Chemical Industry on the 13th February.

CORRESPONDENCE

Sir Frank Smith, K.C.B., C.B.E., D.Sc., LL.D., Sec. R.S., Secretary of the Department of Scientific and Industrial Research.

" Your very able paper provides both the stimulus and the material for a lengthy discussion, and I must confine myself to one or two remarks which I hope may be suggestive, and thus serve your purpose in so kindly inviting me to comment on it.

" I entirely accept your main thesis, that it is desirable that provision should be made in the Universities for special post-graduate training in ' food technology ' (though I should prefer to call it ' food science '), and that unless the ' technologist ' has had a really adequate training he will fail in his primary task of providing the bridge between science and the food industry.

" If, as you propose and I agree, the post-graduate course should be a University one, it follows, I think, that it could not be set solely against an industrial background, but would need to include the broader aspects of the subject. What I have in mind is an honours degree course in pure science, according to the individual's special abilities and inclinations, followed by a post-graduate course, having three broad aims : First, the general biology of food, from synthesis by the plant to human nutrition; secondly, the behaviour and properties of foodstuffs approached from the point of view of general principles rather than commodities; and, thirdly, an outline of the technical processes of storage, processing, and manufacture. I should not myself be disposed to encourage definite technological training, even at the post-graduate stage; that, to my mind, is best acquired in the industry itself.

" It might be of interest to the meeting to know that during the last two years the lectures described on the enclosed list have been given at the Low Temperature Research Station, Cambridge, by members of the staff and others, under the general title of ' Lectures on Certain Problems Related to the Biology and Chemistry of Food Preservation '.

" To return to the question of the availability of the results of research for teaching purposes, the fact that the results obtained by Research Associations are not all published does not imply that they cannot and are failing to play their part in promoting higher technical education, nor does it follow in fact that the publication of the latest results is essential to that end. Research Associations have in fact occasion more than most Research Organisations to realise the need for higher technical education. The infiltration of scientifically equipped men into industry facilitates that close liaison between them and the firms, and the ready appreciation by the firms of the research results, which is a condition of their existence.

" Particularly does this apply in industries of the older type which have had no scientific basis. It is not surprising therefore to find that a number of Associations are in fact taking an active part in promoting education in industry. A recent and prominent example is provided by the Cast Iron Research Association, which has taken the initiative in the establishment of a school for higher foundry education, which it is hoped will be launched in October next, in which promising young men in industry may receive scientific training. Promises of support for this venture have been recently received from other co-operative Research Organisations concerned with foundry problems. And again, Textile Research Associations are actively co-operating in educational work. Others might be mentioned. Research Associations are playing a part in another way, for it frequently happens that men who have spent some time as workers in their laboratories leave to take posts in industry —a movement which is not discouraged by Associations, even though it may lead to some dislocation of their programmes, but they recognise that the tendency is a healthy one and makes for the good of the industry as a whole."

T. Moran, D.Sc., Ph.D., Low Temperature Research Station, Cambridge.

" I have never worked in a food factory, so therefore I am rather hazy about the duties of a food technologist. At the same time I can't help feeling that Dr. Cronshaw has over-stated his case. Is this extensive post-graduate training really necessary, shall I say, in the majority of cases? As I know it the food industry is made up of specialists—specialists in the technique they use or the material they handle. I would have thought that given an adequate training in chemistry and biology and biochemistry a man should be ready to specialise in any branch of the food industry.

" Incidentally I most certainly agree that a chemical training alone is not sufficient. At the same time a training in physical chemistry is of first importance since most problems in food science must be dealt with in a quantitative fashion.

" A study of the regulations for the Natural Sciences Tripos at Cambridge will show that most (all?) of the basic knowledge necessary for a food technologist is covered by this course. With this training I feel that a man would be ready to specialise, and depending on his job, be it meat, milk, brewing, storage and transport, etc., let him then go to the appropriate centre for such specialised training and research."

We may take it as firmly established that the training in basic sciences should be up to University degree standard. In the paper it did not appear to be necessary to enlarge upon this essential point as it is one with which most people will agree.

I am glad that Dr. Moran has raised so vital a question when he asks: " Is the post-graduate course really necessary?" I am not, of course, going to say that it is absolutely essential, but most of my paper was intended to show that a post-graduate course is a very great advantage to both student and industry. Why should food be an exception to a rule which has been of enormous benefit in practically every other branch of industry? I have discussed this point in the paper, and Mr. Bennion has also supplied an answer. But, apart from this, the post-graduate course constitutes a very necessary transitional stage (or a " bridge ", as Sir Frank Smith puts it) in the passage from school to industry. Without it the change over would be too abrupt and drastic. In some cases the shock is so great that the student takes years to recover; sometimes he retreats permanently into the laboratory. It enables him to get the proper perspective; to adjust or orientate himself towards an entirely new set of conditions. There is just as much neces-

sity for this transitional stage as there is in stepping up from laboratory apparatus to works plant. It supplies him with a broad technological basis, which is just as important as a broad basis of scientific knowledge, and in this way checks premature specialisation. So equipped, the student has greater freedom of choice as regards appointments, because the fundamentals of processing operations which he has studied in the post-graduate course and the semi-large plant which he has handled are common to most branches of the food and also other related branches of industry. His field is thereby considerably widened and his self-confidence is correspondingly increased. He is saved the ignominy and embarrassment of being a "fish out of water"—of feeling helpless in a highly critical atmosphere. Moreover, there is the manufacturer's point of view. He expects to get someone who will, within reason, be of some immediate use on the works. Indeed, he usually advertises for a chemist "who has had some experience in——" One might safely predict that if a supply of food technologists (as distinct from pure chemists) were available, the demand for such men would go up by leaps and bounds. (See also Mr. Bates' letter.)

E. P. Bates, M.A., Principal of Hull Technical College.

"I have read your advance paper on the training of the food technologist with care and interest.

"So far as I can understand it, your aim is to train a body of research chemists who are capable of acting as directive agents either in research laboratories or in charge of the research departments of large firms engaged in the manufacture or distribution of foodstuffs, and, if this is the case, I have no criticisms to extend either on your views or on the outline syllabus you lay down for a post-graduate course.

"There is, however, the point that a considerable proportion of the persons so trained would fail to prove their utility to the industrial firm by reason of their inability to translate into actual practice the suggestions laid down.

"We handle this same problem in Hull, which is concerned with flour and rice milling, oil manufacture, fisheries, and agricultural produce. The highly-trained research chemist who is engaged in local industry is chosen as a hit-or-miss proposition. His academic qualifications are always good, but whether he will prove able to 'get over' his ideas and to convert the foremen and the rank and file can only be ascertained in actual experience. The great difficulty is to translate test-tube methods or small-scale operations into the large-scale operation required for successful business.

"In one direction I appear to disagree with your views. Food technology I take to be concerned mainly with chemical engineering, which is neither engineering nor chemistry.

"The problem of the technical college is different from the one you enunciate. We have to deal with the rank and file who need information putting over to them in less technical language and with some due relation to the way in which the factory or the farm or the workshop has to be run. It by no means follows that a process which is successful in the laboratory can be easily or successfully applied on the big scale. Particularly it is difficult to make clear to the rank and file of the workers why a process has to be carried out in a specified manner and what relation it has to the whole work of the factory.

"As I see it at present we have an abundance of literature of a highly technical character coming from research staffs, but we lack both the teachers to analyse and apply these results to local conditions, and we have also the difficulty of getting such methods adopted and loyally carried out by the rank and file in industry.

"I wholly agree with you that there is need for food technology to be marked off as a special branch and to be developed to a far greater extent than has hitherto been the case."

Professor H. E. Watson, Head of Department of Chemical Engineering, University of London.

"I should like to mention that I disagree entirely with your suggestion that a biochemist, after a short period spent in a factory, is able to judge the suitability of different types of plant for some particular operation."

This is a misunderstanding of my meaning. It has evidently not been made clear in the paper that the post-graduate course labelled "Scientific Principles of Preservation"—and of Baking and Confectionery—are intended to incorporate the theoretical and practical study of such processes as size reduction and grading, mixing, evaporation, drying, sterilisation, heat transfer, and so on. Actually these constitute the very foundation stones of factory processes, and they must, therefore, occupy a similar position in the post-graduate studies. The student would have to carry out experimental work with representative pieces of equipment such as retorts (of the kind used in canning operations); size reduction mills; mixers; curing and pickling vats; homogenisers; drying and baking ovens; boiling pans for sugar, jam, etc.; refrigerated chambers; and so forth.

What is implied in the paper under the heading of "Engineering" is that the ordinary post-graduate course in chemical engineering cannot, in itself, substitute the scheme of training suggested above as one likely to meet the particular requirements of the food technologist. The scientific principles of food preservation and manufacture demand for their exposition a course of training which has been expressly designed for the purpose, and it is for this reason, and because of the danger of confusion with mechanical and constructional engineering, that the coupling of the word "engineering" with food, chemistry, or biology has been deliberately avoided. "Food Processing" would probably be a better term.

Head of the Chemistry Department, Hull Technical College.

"The author is to be congratulated in pointing out the desirability of courses in Food Technology. He must realise, however, that if these courses are to be a success the support and confidence of food manufacturers is essential. This can be achieved by making the training as practical as possible.

"The proposed exclusion of Chemical Engineering in a subject of this character is illogical, as the quality of manufactured food depends largely upon the kind of plant employed and the method by which it is controlled. Research in food technology will be regarded by manufacturers as so much wasted time unless the research worker is able to compile a technical report and make practical suggestions as to how his work can be carried out on a large scale.

"Finally, it would be advisable to include in the course the general principles of costing and a working knowledge of factory organisation."

It is not proposed to exclude the elements of process operations. (See the reply to Professor Watson.)

F. C. Bullock, B.Sc., F.I.C., Public Analyst for the City of Leicester.

"I consider you have opened up a subject of very great importance. But alongside the need of facilities for obtaining organised instruction in Food Technology exists the need of some qualifications which should be compulsory for persons wishing to engage themselves in some branch of food manufacture. It is necessary to give some definite proof of proficiency before one can practise medicine, extract teeth, dispense poisons, or drive a car; but, at present, so far as I can see, any amateur, having tried and failed at other occupations, is open to 'try his hand' at small-scale manufacture of ice-cream, jams, sweets, cakes, etc., without any training or qualification whatever; and in the average town, even if he wished it, he would not necessarily find instructional courses to meet his requirements.

"Degree men who had subsequently taken a course in Food Technology would make an ideal liaison for translating the findings of the research workers into works practice.

"I think the next move rests with food manufacturers, and am convinced that if a sufficient demand were demonstrated the Universities and colleges would rise to the occasion."

Dr. E. H. Callow, Low Temperature Research Station, Cambridge.

"It does seem essential that the food technologist should be well trained in fundamentals and then spend a year or more doing post-graduate work. The degree of diploma awarded for this work would be a very necessary hall-mark. Men trained in this way would be of immediate value to industry. I believe that at present it takes about three years for a graduate to settle down in the food industries. I do know that it is impossible to persuade many firms to employ a food technologist just because of this lag period. If only there were more food technologists at our bacon factories, my own work would be considerably easier."

T. N. Morris, M.A., Low Temperature Research Station, Cambridge.

"I find Dr. Cronshaw's address such a complete statement of principle that there seems nothing to add to it. Neither is there, in my opinion, anything to subtract from it, and it now remains to work out the details of a scheme."

R. S. Potter, B.Sc., A.I.C., Food Technologist, Fardon's Vinegar Co., Ltd., Birmingham.

"I hope your paper will get the support it deserves. Every chemist connected with the food industry must, at some time or other, have felt the need of some such training as you suggest."

Sir Edgar Jones, K.B.E., National Food Canning Council.

"I think you are opening up with your great knowledge and ability an important subject that is ripe for treatment. It is my view that the time has come for the Universities to add a new Faculty. They have courses for degrees in Applied Science and Engineering and the Engineering degree leads to specialisation for Coal Mining, Marine Engineering, Electrical Engineering, etc. The preparation of food is a wider and more important activity in modern life than any other separate activity. There ought therefore to be a balanced University course, leading up to a degree in Food Technology, followed by a post-graduate course of specialisation in one or other of the specific branches.

"I trust that your paper will help towards this new departure in University curricula."

H. V. Taylor, O.B.E., B.Sc., A.R.C.S., Ministry of Agriculture and Fisheries.

"This country can be proud of the fact that it has long had courses in the fundamental sciences upon which all technology rests. In this century, however, it was realised that the sciences were academic and that the teachers were mainly concerned with their subject over a wide field and not their intense application in one special, narrow field. Consequently, where industries were concerned, it was soon found that a new type of organisation should come into being to bridge the gap between fundamental science and practice.

"In fruit and vegetable production this took the form of special research stations, and the intensified application of the sciences to a few products resulted in a special technique which had not previously been available. But before these useful results could be obtained it was necessary for the scientists to become technologists by concentrated study in a narrow field.

"I think it would be correct to say that the same would be true of the food industries. Probably they would not be able to make the fullest use of science, and science would not be able to assist fully the industries, because of the gap between them. It would be necessary to have scientists working in this more restricted field to work out the technology involved.

"In the Horticultural field the Research Stations and the technologists have been created, and now the University of Reading quite recently created a Chair of Horticulture and a Department in which the training of future horticultural technologists would be done. The analogy seems to indicate that sooner or later one or other of the Universities of this country will identify itself with the problem of food, and perhaps create a Department where scientists who are receiving their courses in the fundamental sciences can be instructed how to apply these to the best advantage to the problems concerning food manufacture.

"Perhaps Dr. Cronshaw's illuminating paper may provide the stimulus for this subject to receive further consideration by the Universities concerned."

G. W. Lacey, B.Sc., A.I.C., Chemical Engineer.

"Dr. Cronshaw's paper fills me with amazement if not alarm. His comprehension of the technical requirements of the great and diversely composed group of industries engaged in food growing, manufacturing, and preserving has been admirably expressed and is unchallengeable. But the fact that no organised technological training of a scientific nature is available is sufficient cause for alarm in these days of rapid industrial progress. Indeed it seems absurd that the training of scientific workers and technical men for the largest and most important of all the industries affecting the well-being of our people should have received so little attention, whilst less vital industries have either created facilities or taken advantage of existing institutions and organisations.

"It is imperative that something should be done in a properly organised fashion to train food technologists and, as Dr. Cronshaw also urges, to link up the results of research work with the many ramifications of the industries concerned. In many other industries knowledge and teaching have been aided by the endowment of Chairs in our Universities. Could not some of our food industrialists afford to do the same?

"The value of science applied to food manufacture has for a long time been recognised by the technical publications serving the industries and in the comparatively recent formation of the Food Group of the Society of Chemical Industry; and whilst much information has been disseminated through these channels, not by any means sufficient scientific or technical matter is or is allowed to be published for the immediate benefit of small as well as large commercial undertakings. With the establishment of trained food technologists in executive positions the demand for collected and complete information will have to be met. There is therefore ample opportunity for co-operative effort with a view to improving this situation.

"Finally, I must say it is not clear to me from Dr. Cronshaw's paper whether the trainee would receive any instruction in chemical engineering, or perhaps a better term would be 'process operation'. The more or less academically trained man, even though he takes a post-graduate course in applied sciences, often proceeds after initial service in a works laboratory to some investigation in the works itself, and then bumps up against large-scale operations of plant and equipment of which he has little or no knowledge, either of how it works or how it was designed and built, or even of what metals or materials it is constructed. This is to my mind the greatest embarrassment that the University trained man has to overcome when he first joins issue with the production side of the business he has entered. Some instruction in the general principles of engineering design, with operation of plant on a small scale, and a knowledge of the resistance to corrosion of metallic and other structural materials therefore seems to be essential. It also follows from this that more communications by men experienced in the practical problems of production would be extremely valuable."

I am in entire agreement with Mr. Lacey on the necessity for including the scientific study of "process operations" in the post-graduate course.

T. H. Fairbrother, M.Sc., F.I.C., Cereal Chemist, Messrs. MacDougals Ltd., London.

"I am in agreement with you as to the need for the provision of an adequate training for food technologists, but there are difficulties in the scheme which you offer! One is that the chemical student, on obtaining his degree, has no idea of what branch of industry he is going to enter; he hopes, often with justice, that his broad scientific training will enable him to assimilate rapidly the needs of his job.

I admit that in my own case an institute of advanced food technology, with one section devoted to the application of science (not just chemistry) to flour milling, would have been very useful. I have found that the chemist in a flour mill must be a skilled microscopist, a good physicist, something of an engineer, with a little of the publicity agent and sales management thrown in. There ought to be available to him an institute offering a rapid course of training in the microscopy of cereals—with slides of wheat, starch, etc. My idea is to have an Institute of Food Technology attached preferably to every University. This should be so staffed as to be able to offer post-graduate training to well-qualified chemists in any required branch of food science. The food industries themselves should be urged to support such Institutes financially and encouraged to send their chemists to such courses as are necessary. I should also like to see Research Institutes in the middle of the agricultural areas where training of a specialised nature could be given."

I think that once the industry sees the advantage of engaging properly trained men, the Institute of Food Technology will not lack post-graduate students, including those who have just graduated and those who, as Mr. Fairbrother suggests, return from industry for a "refresher" course.

T. Crosbie Walsh, F.I.C., Consulting Food Technologist.

"If a young man goes to the trouble and expense of taking post-graduate courses, will he find an outlet for his knowledge or will he be pitchforked into a works laboratory and told to mind his own business? This has been very much my experience, but if the old order of things has improved in favour of more ample scope for the chemist, so much the better.

"The reproach has often been hurled at the chemist that he is not industrially minded. Obviously, he can hardly be expected to be a seasoned industrialist on leaving college. Furthermore, it is possible that difficulties may be placed in his way by his employers.

"Dr. Cronshaw's suggestion that the student should actually handle representative plant is sound, and this should come early on in the course, as this practical work will serve as a big incentive to delve deeper into theoretical considerations. He should have a working knowledge of the principles of evaporation, heating, steam raising, and so on. He should be able to handle a retort and also a triple-effect evaporator. By this means he will be able to select plant intelligently and to avoid unnecessary expense on refinements. He should be able to read a machine drawing. There is no need for him to bother about questions of design, but I emphatically think he should be capable of making a selection of the type of plant he requires for a particular purpose."

H. C. Moir, B.Sc., F.I.C., Food Technologist, Wm. Beattie Ltd., Glasgow.

Mr. Moir has found that the elementary half-course of engineering and engineering drawing given in Glasgow University to students of Applied Chemistry has been of the greatest service to him. A Food Technologist should be able to read a blue print intelligently.

D. Humphrey, B.A., B.Sc., Director of Education, The Polytechnic, Regent Street, London.

"I quite agree with your remarks as to the courses of training. The preliminary course in chemistry, physics, and biology is an ideal one. We find, however, that there is so little demand for instruction in foodstuffs that it is impossible to organise courses for it."

Dr. E. A. Fisher, M.A., B.Sc., D.Sc., F.I.C., Director of the Research Association of British Flour Millers.

"One or two points occur to me in connection with your paper. There is no food industry, only a large number of entirely independent, often mutually exclusive and sometimes mutually competitive industries. This does seem to me a matter of material concern, and it does complicate the problem. It is probably the cause of the fact that, unlike the petroleum industry, there has been so small a demand for technical specialists from within the food industries. Moreover, the petroleum industry, to a great extent, provided the money for training the specialists required. The multiplicity of interests within the food group of industries would militate against the provision of the funds necessary to supply the instruction you visualise; and if the food industries won't provide the money, who will?

"Then, again, the variety of technical processes is very great. There is little similarity between, say, the smoking of haddock and the canning of meat, on the one hand, and the manufacture of chocolate or of Turkish Delight on the other. True, both branches of industry rest on the same foundation of chemistry and physics, plus biology; but so does the whole of industry. One would, however, scarcely recommend courses of instruction with a view to turning out technologists—without any prefix. I am inclined to think that food technology is too wide a subject to form the basis of courses of instruction unless it is dealt with in a very general way—*e.g.*, as chemical engineering is taught. (Incidentally, you say nothing about the provision of the necessary teachers—a very real difficulty.)

"My own view I would express shortly as follows: the first object of a University is to educate, on the scientific side, by means of chemistry, physics, biology, etc. Nothing can take the place of this fundamental and essential mental discipline. A University in the first instance should not try to produce chemists, engineers, or medical doctors, but rather to educate the student so that he will stand a better chance of becoming a good chemist, engineer, or medico than if he had been educated in some other way. It is significant that the leaders of the great professions—the Law, the Church, Medicine—rarely study law, theology, or medicine for their first degrees. They get an education first and take up their professional studies after graduation.

"I would like to see science degree courses regarded first of all as education. Then if a man wishes to enter industry on the technical side he should pursue a post-graduation course leading to the M.Sc. degree or a Diploma in textile technology, chemical engineering, *food technology*, and so on. There would thus be the same 'pool' of educated, partially trained, but inexperienced, ability for industry to draw on to satisfy her special needs. After gaining the necessary experience in industry itself, one man would develop into a chief research chemist, another into a chief works chemist, another into a works manager, another into a technical director with a seat on the board. All four types require the same kind of intellectual outfit; when they get into industry their paths will diverge according to circumstances, opportunity, and perhaps tastes.

"As regards the rank and file, those who will occupy junior positions, a large and essential class of worker, they seem to be reasonably well cared for, although I agree that much could be done in the way of improving the courses of instruction and of providing new ones, especially in the food technologies."

There is no essential difference between our viewpoints.

Dr. John Boyd Orr, F.R.S., Director of the Rowett Research Institute, Aberdeen.

"Agriculture is at present undergoing a revolution somewhat akin to that which took place in Industry during the nineteenth century. Instead of farms being self-contained units, each attempting to produce all the various kinds of agricultural products used in the district, they are tending to specialise in the products for which their particular soil and climatic conditions most adapt them.

"Improved processes of food preservation help to accelerate this, and, unless some political action prevents it, the trend of farming will be to reorganise on specialist lines, and the processing centres will be located in the districts where products can be most cheaply produced. As production fluctuates so much from one season to another, it is necessary to have factories in these areas where a surplus can be taken off the market and preserved. The use of preserved and precooked foods will increase; undoubtedly, therefore, great scope exists for expansion in the food preservation industries, a development which is not likely to be held up on account of either health or taste."

T. McLachlan, F.I.C., Public Analyst and Consulting Chemist.

"On one point I would join issue with Dr. Cronshaw when he claims that the food technologist should not know anything of chemical engineering. I would ask him how one is to be qualified to judge the value of different pieces of plant submitted by rival engineers if one is ignorant of the first principles of construction or of reading a blue print. The food technologist will, in fact, have to decide whether to employ a vacuum or pressure filtration, the type of filter bed necessary to obtain efficient filtration, the pressure required to rupture cell walls, whether extraction should be made hot or cold, etc., and, according to the decision, what type of plant is required. I submit that the whole problem of food preparation and storage is largely one vast chemical engineering problem.

"I do not think, however, that there is any fundamental difference of opinion between Dr. Cronshaw and myself, except that he, as a former University professor, has attempted to mould his training on conditions already existing in the Universities, whereas I am asking whether the curricula of the modern University fit in with present-day requirements.

"My own opinion is that the student should enter the University at the age of 16 and that the food technologist's training must be more on the lines of that given in the older technical colleges, with a little more theory introduced into the lectures.

"At Finsbury Technical College we were taught to brew beer on a small scale, and to rectify our alcohol from the final product; to make soap from scrap fat obtained from the market, and so on; and my opinion is that the student should still be trained in processes of this sort, studying the underlying principles and learning to diagnose where his preparation has gone wrong. For the first two years I would suggest a course of mathematics (including calculus, mechanics, and mechanical drawing), physics, chemistry, biology, and a language. This would enable the student to pass on in the final years to a proper study of processes, microbiology, and so on.

"I am also strongly in favour of Dr. Cronshaw's idea of Industrial Research Fellowships."

I quite agree with Mr. McLachlan's insistence on studying the underlying principles of processes and learning to diagnose difficulties which arise. I am glad to see that he thinks well of Industrial Research Fellowships; these would link up the Institute of Food Technology with industry and might easily form a strong nucleus for such an Institute in its early stages.

Professor G. R. Clemo, D.Sc., F.I.C., Director of the Department of Chemistry University of Durham.

"I have read with much interest your paper. With regard to the sections dealing with the courses of student training for those who are likely to occupy responsible positions in the Food Industry, I can say that I consider our Chemistry Degree courses here are eminently suitable (compare p. 22 of your reprint). Thus our students in the Honours School of Chemistry read three subjects other than Chemistry during their first two years, and over half of them select the combination Physics, Botany (including Plant Physiology), and either Bacteriology or Physiology or Agricultural Chemistry.

"Their work in organic chemistry has a distinct biochemical bias, and altogether our graduates are well equipped for the post-graduate study of food problems.

"Further, this session two men are taking Chemistry and Bacteriology as their two main subjects for the Pass B.Sc. course."

Dr. H. Kennedy, Secretary of the Irish Agricultural Organisation Society, Ltd.

"I regret that I cannot be in London to hear, and possibly take part in, the discussion. I may say, however, that in my opinion you have chosen a most suitable subject at a psychological moment. I myself have felt the want of such an institute as you suggest, both from the point of training food technologists and also for co-ordinating research in food technology."

W. H. Nevell, Principal of the L.C.C. Smithfield Meat Trades Institute.

"There is no doubt that from the meat trade point of view it is ill served technologically. It would be safe to say that the rank and file manufacturer of most products has only the most rudimentary ideas of scientific control. His methods are frequently based on the rule of thumb practices of the reigning shop foreman. As the scope of a business increases one sees a yearning on the part of proprietors for some kind of scientific guidance. Unfortunately scientific opinion is rarely sought until some form of trouble occurs.

"It is certain that many firms do require the occasional services of scientific experts and will blindly follow the rulings of such. As to whether they would do so with a regular employee is another matter, but it certainly seems to me that the personality of the technologist should be such as to overcome both managerial and production interferences. So often, even the very able student lacks power in this direction.

"Knowing fairly intimately the needs of the meat industry and assuming the problems in other fields of food production are as wide, one is led to suppose that unless the projected scheme provided for final specialisation on a particular side, the danger of creating a number of 'Jacks-of-all-trades' is highly probable. If the technologist is to be 'The Pivot on which the whole organisation of production turns' (as is suggested in galley 2, par. 5), it seems more than ever important that specialisation will be demanded by the employing organisation.

"None the less, I welcome your suggestions, and am sure it is a step in the right direction to relieve the business organisation of masses of technical investigations in respect of the raw materials of manufacture."

See the reply to Dr. Moran's letter.

S. W. Butterworth, B.Sc., A.I.C., Head of the Bakery Department of the Leeds College of Technology.

"I was fortunate in being able to take, in 1922-1926, along with two others, a course in Foodstuffs under James Grant, the founder of the sub-department of Foodstuffs at the Manchester College of Technology, and later under Dr. T. K. Walker, the present chief. At that time it was included in the department of chemistry under Professor Pyman, F.R.S."

Mr. Butterworth has supplied details of the Manchester Foodstuffs course and vouches for the great value that it has been to him in the foodstuffs industry. One gathers the impression that this course was of a pre-graduate technological nature. It was, nevertheless, remarkably thorough and comprehensive.

H. E. Monk, B.Sc., F.I.C., Public Analyst for the City of Salford.

"It seems to me that Dr. Cronshaw, in his capacity of counsel for the prosecution, has made out a powerful and unanswerable case in his indictment of the system (or lack of system) which has, in this country, resulted in there being no department of food technology in any University or other institution.

"Such being the case, it is now far more urgent and important to discuss how a school of post-graduate training is going to be brought into being than to spend too much time in argument as to what exactly such a school should be.

"Dr. Cronshaw has given us what appears to be at least a working basis for the aims and syllabus of a proposed school or department, although I do not agree with him on some points of detail. I would suggest that the subjects of nutrition and dietetics be included. But the important thing

is to get your department going and it would have enough elasticity to shape its own course.

"The difficult question really comes to this, 'Do you know of someone with a genial and enlightened outlook and also with £50,000 to spare?' Perhaps you could get started with less."

THE DISCUSSION

A. L. Bacharach, M.A., F.I.C., Chief Chemist, Glaxo Laboratories.

Mr. Bacharach was unconvinced that the training of the food technologist should be so very different from the training of other technologists and of those who were to continue pure research in food and, therefore, were not strictly covered by the term "technologists".

He could not see how the problem of the post-graduate training of the food technologist was to be isolated from the pre-graduate training.

He was forced to the view that it would be utterly impossible to expect any man entering food technology to acquire, except by mere luck, most of the special technique he would be called upon to use. This led to the view that food technology, like every other technology, was a branch of applied science and not an accumulation of knowledge derived from separate sciences.

Mr. Bacharach's view was that the potential technologist should be equipped with analytical chemistry, practical engineering (including the ability to read blue prints), mathematics, general biology, an ability to use his own language, and Latin.

The first point made by Mr. Bacharach is difficult to comprehend. Would he have us believe that food, fuel, petroleum, glass, textile, pottery, metal, and all other technologists should have the same training? It is entirely inconceivable!

I certainly agree with his second point.

The object of a post-graduate course is not to train a man in any special technique, but to initiate him in applying his basic knowledge to a particular department of industry. It is, as Mr. Bacharach says, a branch of applied science.

One would imagine that ability to use one's own language should be the backbone of that early period of one's life, from cradle to the time of entering the University, otherwise something is wrong with both home and school. The same applies to Latin. Personally, I regret that the time which I spent on Latin was not devoted to German instead. I also hold that it is more important for a technologist to speak the language of the foreman than that of the boardroom.

Professor V. H. Blackman, M.A., D.Sc., F.R.S., Director of the Biological Laboratories, Imperial College of Science and Technology.

Professor Blackman commented on the great diversity of the materials of food which constituted one of the difficulties of the subject and of any training in it. He agreed that a case had been made out for food technology as a subject for a University Department. At the same time, the really important thing was the pre-graduate training. It seemed that, as Dr. Cronshaw had suggested, the subjects ought to be chemistry, physics, mathematics, and biology. He welcomed Dr. Cronshaw's insistence on biology, bacteriology, and mycology.

He also agreed that, as regards post-graduate work, all that was required was to teach the student the scientific principles of the subject. But the student should also be kept in touch with his future work by visiting factories and listening to lectures by experts. He also joined with Dr. Cronshaw in stressing the importance of microscopical studies.

Any University Department in food technology—and he urged that such should be started—should not confine itself to teaching, but should keep its scientific soul alive by engaging in a certain amount of fundamental research.

F. Kidd, M.A., D.Sc., Superintendent of the Low Temperature Research Station, Cambridge.

Dr. Kidd said that he and his colleagues had had a growing feeling that, through their contacts on the one side with application and on the other side with the University student, there was a developing field of interest which would in time constitute the possibility of a department of University teaching. The late Sir William Hardy had always had in mind the possibility of the development of some teaching in connection with the work on the food preservation side of the industry.

Professor R. H. Hopkins, D.Sc., F.I.C., Department of Brewing and Fermentation, Birmingham University.

Professor Hopkins said that in the main he concurred with Dr. Cronshaw's suggestions in connection with pre-graduate training. He could point to no greater proof than the fact that the courses for which he was responsible in Birmingham were modelled on the lines laid out in the paper. The Department at Birmingham had its centre in brewing, from which it spread out to cover associated food industries—*i.e.*, those which came nearest to the fermentation industries. Among those trained by his predecessors were Dr. Lampitt and Dr. Anderson; so that the Department could claim to have been doing something towards filling the gap, which was so painfully apparent, in the training of food chemists in this country. He reinforced the remarks made upon the importance of a good pre-graduate training. A period of four years was fully needed for training in general principles alone, in chemistry, biology, bacteriology and engineering. His experience of teaching had led him to the conclusion that the average student learned too many facts and not sufficient principles, even in four years, and Professor Hopkins declared himself to be all out for reducing the number of facts to be memorised and for devoting more and more attention to principles.

The food technologist was more competent than he to judge of the post-graduate course, but he was sceptical as to the desirability of going further than a one-year general training. The previous training was the all-important factor, and a man having the proper previous training should be able to adapt himself to whatever industry he entered.

I am in agreement with Professor Hopkins' last remarks if he refers to a one-year general training in the scientific principles of the preservation and manufacture of foodstuffs.

Professor J. Kenner, D.Sc., Ph.D., F.R.S., Professor of Technological Chemistry in the University of Manchester and in the Municipal College of Technology.

Professor Kenner stressed the importance of basic principles as enabling a student to adjust himself easily to the special requirements of a research station or an industrial concern.

Commonly, nowadays, students entered the University at a stage equivalent to the intermediate stage and took a three years' course. The final year in that course would be equivalent to a one-year post-graduate course as conceived by Dr. Cronshaw.

There had been for some time at the Manchester College of Technology a three years' honours course in food technology, or the chemistry of foodstuffs, as it is called, starting in that manner. Recently some training in the problem of refrigeration had been included.

He agreed with Dr. Cronshaw that there should be a thorough training in organic and physical chemistry, but he did not think that Dr. Cronshaw had given sufficient value to mathematics.

At Manchester they did not give a general training in biology, but they dealt with such matters as enzyme action, micro-organisms, antiseptics, food and water analysis, the processes of growth, decay, digestion, and assimilation.

The technologist should have some idea of industrial administration and an appreciation of questions of costing. Engineering training also was very valuable and he did not, as many others did not, agree with Dr. Underwood's views.

Chemical engineering was concerned with physical operations in relation to chemical reactions and should therefore be controlled by chemists.

Firms in this country were not so willing as those in America to allow students into their works for experimental investigations. That was a difficulty which had to be faced.

He doubted whether a University institution should be concerned with large-scale operations relating to some particular industry, such as bacon curing or other operations to which Dr. Cronshaw had referred and which required special plant. That was the province of the Research Station.

Finally, Professor Kenner did not think that Dr. Cronshaw had done justice to Manchester in overlooking the course in food technology and the chemistry of foodstuffs which was operating at the College of Technology.

I have assumed in the paper that the standard of instruction in mathematics is sufficient for the needs of the course in physical chemistry.

As regards bacon curing, etc., the whole essence of post-graduate work is to instruct the student in the scientific principles of the various preserving processes, largely by experimental work using small (not large) scale plant. I suspect that herein lies the explanation of the misunderstanding which appears to have arisen in respect of the Manchester courses in food technology. I expressed at the meeting, and do so here again, my apologies for having omitted to refer to the lead taken by Manchester in this aspect of technological education. At the same time, I do not think we altogether agree as to the form in which this instruction should take place. As I see it, Manchester is unduly loaded on the fermentation, bakery and food analysis side, whereas I would prefer to see this balanced by the inclusion of the principles of food preservation as outlined in the paper.

T. K. Walker, Ph.D., D.Sc., F.I.C., Lecturer in applied Chemistry in the University and the College of Technology, Manchester.

Mr. Walker made it quite clear that the course in foodstuffs at the Manchester Technical College was in effect the honours course in chemistry, with foodstuffs and several allied subjects taken as special courses for that degree. They insisted on students taking physical and organic chemistry and mathematics to the standard of the honours degree in the final B.Sc. The research side is stressed and students are urged to consult original papers.

R. L. Collett, M.A., F.I.C., Assistant Secretary of Institute of Chemistry.

Mr. Collett thought that a man with a really fundamental scientific training and outlook would be, in the long run, more useful to the industry than any man trained on *ad hoc* lines.

He asked, was it wise to advise a man to take a course which might fit him for one particular industry, but not for any other? The great asset which a man derived from a scientific training was that he could apply it to a very wide range of industries. Several speakers had, in fact, admitted that they had drifted into the food industry. Could the food industries guarantee a career to a young man who took an *ad hoc* course? Mr. Collett did not think so.

Mr. Collett appears to imagine that because in the past chemists have drifted into the food industry, the same policy of drift should be allowed to continue, especially in view of the rate at which the scientific study of preservation, etc., is advancing nowadays. I have already remarked on the necessity for a transitional or post-graduate stage. Would Mr. Collett put the clock back by wiping out all that has been done to build up technological training for the fuel, petroleum, and other industries? To me Mr. Collett appears to advocate retrogression. If the food industry (which, by the way, already takes more chemists than any other branch of industry) does not clamour for properly trained food technologists, that does not mean to say that its attitude is incapable of change. One has only to think of the revolution in outlook (with corresponding benefit to industry) which men like Dr. Mellor and Professor Turner have brought about to feel quite convinced that what they have done for their particular departments of industry can be done also for the food industry. When we can supply the food industry with properly trained men—not merely chemists of the old-fashioned school, but food technologists as defined in the paper—the demand for such men will grow by leaps and bounds.

H. J. Page, M.B.E., B.Sc., F.I.C., Controller of Agricultural Research, I.C.I. Agricultural Research Station.

Mr. Page was tempted to wonder why agriculture was extremely well equipped with courses of training, agricultural colleges, research stations, and so on, whereas that was not so in the case of food technology. The answer was, obviously, that agriculture was an art which had been in existence from earliest times, whereas food technology was a science which, until quite recently, mankind had managed to do without.

Mr. Page agreed with previous speakers as to the fundamental importance of an all-round training in pure science rather than an *ad hoc* training. A man with a good all-round training in pure science could be relied upon to make his mark in quite diverse branches of applied science. There was a very serious danger in the tendency towards too early specialisation. Of course, it was necessary to distinguish, in the case of food technologists, between the training of the man who had to direct processing industries and the training of the man who had to engage in experimental and research work for the development of new processes and the advancement of industry. A man who was to be an efficient plant or factory manager could leave pure science at a much earlier stage and could commence to specialise rather sooner than the man who had to engage on the research side.

No one has disputed or can dispute the necessity for an all-round training in pure science and there is no intention of attempting to substitute this by an applied course. The two are simply complementary. There is no question of a choice between a scientific and an ad hoc *training. It is difficult to see in what sense Mr. Page uses the term "specialisation". I do not consider that a post-graduate course in food technology is one of specialisation; just the reverse, in fact. One of its objects is to delay any tendency towards specialisation* —i.e., *in meat, fruit, dairy work, etc. —until the student has actually passed into industry. The post-graduate course then remains as a general background of science applied to a wide field of industry.*

E. B. Bennion, M.Sc., A.I.C., Head of the National Bakery School, London.

Mr. Bennion, who remarked that the discussion had been essentially on the academic plane, said that the food technologist is a most necessary factor in industry as a liaison officer between pure chemist and manufacturer, so that in devising courses for the food technologist it was necessary to get outside the academic walls and to get more closely into touch with the manufacturers who would employ the food technologists when they were trained. The needs of the employers had to be considered as well as the academic requirements in such training.

It was very difficult to get into one's stride when passing direct from an academic training into industry—and in many established chemical industries there was an understanding of that fact. But the food industry was a baby as compared with many others; it was essentially a post-war industry, at any rate on its present-day scale, and consequently the position of the food technologist was only just beginning to be understood.

Mr. Bennion was very much in support of Dr. Cronshaw's scheme, which ought to be developed in conjunction with the industrialist, so that they would not be taking a blind alley training, but would know that there were definite openings for them in the industry. It was that co-operation between the Universities and the industry which would play a most important part in the future development of the food industry.

Our readers are invited to contribute their views to this discussion.

THE NEW "CHEMICAL INDUSTRIES"

A CHANGE of name cannot alter the personality of a great work that has become so well known and widely utilised through successive years of publication as the *Chemical Engineering and Chemical Catalogue* issued in the Tenth Edition by Leonard Hill, Ltd., and now entitled *Chemical Industries*.

Simplification in form has been the aim of the publishers, and in a reference work of this nature serving a great group of industries of very divergent needs, simplification implies improvement in presentation and accessibility of the information sought by the user. Alteration of the order of things might have meant unfamiliarity to those accustomed to the previous editions, but such an ideal arrangement has been achieved that the way to use the book is obvious from a glance at the contents page.

Editorial matter, tables of data, and announcements of manufacturers of plant and materials appropriately illustrating and supplementing the text are grouped, always in this order, under each of the subject headings, marked for quick reference with sectional tabs. Thus all the information regarding a particular subject in which the user may be interested can be found together without repeated reference to the index, whilst the absence of cross referencing throughout the book is a very agreeable feature. The only departure from this straightforward arrangement is the placing of the bibliography of technical books as a separate section at the end; this has been done on account of its classification being more complicated, and much unnecessary repetition under different headings has been avoided by this means.

It would be difficult to make a better choice of names for the ten principal sections, embracing as they do so many related materials and operations, than the following:

I. Corrosion.	II. Power Plant.
III. Chemical Plant.	IV. Size Reduction.
V. Separating.	VI. Handling.
VII. Air Conditioning.	VIII. Instruments.
IX. Chemicals.	X. Fine Chemicals.

The leading section entitled "Corrosion" quite rightly covers "Materials of Construction used in Chemical Industry" and is sub-divided into ferrous and non-ferrous metals, stoneware, silica, bricks, flooring materials, paint, insulating materials, and tower packings. Which is the most suitable material to employ is always the first question to be asked in contemplating the installation of process plant, and resistance to chemical or corrosive action almost invariably determines the answer.

Under "Power Plant", as well as information about boilers, compressors, electric motors, etc., is to be found an important section devoted to water treatment—that is, water filtration and softening—essential to power plant practice but very valuable also in other phases of chemical industry, and especially in food manufacture.

To take yet another instance, "Separating" is combined with "Grading" and includes filtering, drying, distillation, and in fact all operations involving physical separation by any means. Tables of logarithms, conversion tables, etc., are put under the more general heading "Chemical Plant", though being of an elementary nature they might perhaps be more usefully disposed in a section by themselves for frequent quick reference.

As the Publishers' Foreword points out, Section X, dealing with "Fine Chemicals", is a further addition made this year, and is in reality the "Reference and Data Book" which it was intended to bring out as a separate publication for the benefit of manufacturing chemists generally.

Indices follow in Section XI, and last comes the Bibliography extending to 90 pages, with spaces allowed after each subject for noting any new books coming out during the current year.

Assuming experience, it can be no exaggeration to say that by intelligent application of the fundamental and practical knowledge contained in this volume, processes can be evolved and plant designed, existing equipment wisely modernised and the efficiency of chemical and mechanical operations checked and maintained, leading to a realisation of what everyone is seeking: the most economical production consistent with the highest possible equality.

Most people fail to realise, too, that the rate of progress in scientific discovery and applied engineering is to-day so much greater than it was only a few years ago that a work of reference like *Chemical Industries*, in which the co-operation of so many manufacturers is enlisted, must be brought up to date every year. Otherwise the purpose of the book is defeated.

Chemical Industries is edited by Dr. D. M. Newitt, who has been responsible for each of the previous editions under the old title, and he is to be congratulated upon the splendid re-arrangement and the great amount of revisionary and additional work carried out. Even in this enlarged and tremendously improved form, *Chemical Industries* is still published at the small sum of ten shillings.

G. W. L.

Chemical Industries. Edited by D. M. Newitt, Ph.D., B.Sc. (Lond.), D.I.C., A.R.C.S., A.I.C., A.I.Chem.E. 361 pages with Indices: Bibliography, 90 pages. Large quarto. Leonard Hill, Ltd., 231, Strand, London. 10s.

Pacific Fisheries Experimental Station, Prince Rupert, B.C. Bacteriological Laboratories and Refrigeration Department.

COOLING AND FREEZING CURVES FOR FISH

The following account has been taken from a report issued by the Biological Board of Canada in December, 1934.

By O. C. YOUNG

Pacific Fisheries Experimental Station, Prince Rupert, B.C.

IN PROGRESS REPORT No. 17 (1933) Finn discusses some of the factors influencing the rate of freezing and defines the *effective rate* of freezing as being the time taken for the temperature of the warmest portion of the substance being frozen to pass through the interval 41° to 23° F. Then in discussing rapid freezing it is implied that the term should apply only to commodities frozen faster than the *critical rate*, which is the "slowest rate at which tissue may be frozen without appreciably breaking down the cell structure."

Until recently the term *rapid freezing* was associated mainly with those systems of freezing employing the principle of direct or indirect contact with some cold brine, and commodities were said to be rapidly frozen if frozen by one of these *brine* systems, irrespective of the rate at which freezing took place. The term, therefore, lacked definition and could consequently be used more or less indiscriminately. Now a discrimination can be made between slow and rapid freezing by observing the time taken for the temperature to drop through an arbitrary temperature interval.

Though the critical rate for freezing fish is still undetermined, Finn suggests that it will in all probability be approximately the same as for beef—that is, in the neighbourhood of 48 minutes. Fish muscle is much more delicate than beef muscle; furthermore fish are cold blooded; and though it is not known how these factors affect the critical rate of freezing, for want of direct experimental results, the rate discovered for beef may be tentatively assumed for fish.

When commencing work at this Station on the cooling rate of fish, it was found that the critical temperature interval 41° to 23° F. is not very suitable. Though the upper limit of the interval, as long as it is above the freezing point, is of no particular importance, the temperature (41° F.) set by the English investigator Moran for beef is somewhat high for fish, because generally fish which have been stowed in ice do not enter the freezers at 41° F. The interval 32° to 23° F. which most closely coincides with the *zone of maximum crystal formation* (stated to be 31° to 25° F.) would be more suitable, when accompanied by a corresponding change in the time limit. Work recently completed at this Station indicates that if it takes 48 minutes to reduce the temperature of fish steaks from 41° to 23° F., the first 13 minutes are utilised in reducing the temperature to 32° F. and the remaining 35 minutes are taken to reduce the temperature to 23° F. In other words, if the interval selected were 32° to 23° F. instead of 41° to 23° F., the time limit would have to be changed from 48 minutes to 35 minutes to give the same speed of freezing.

The rate at which the temperature of fish may be lowered in a given freezing system, such as sharp freezing by air with natural circulation, or brine freezing with a constant velocity of the brine, depends upon the temperature of the cooling medium (air or brine) and the thickness of the fish to be frozen. Consequently, if the critical cooling rate is known, and given reliable cooling curves (*i.e.*, curves showing the relation between time and temperature for different thicknesses of fish), the optimum operating conditions for the production of a rapidly frozen product may be determined for such a system. If the temperature of the system cannot be altered readily, then the thickness of the product must be changed so as not to exceed a given maximum, or if the thickness of product is fixed at 1-inch fillets or steaks, then the temperature of the system must be altered so that the freezing rate will just exceed the critical rate. It will readily be seen, therefore, that next in importance to knowing the critical rate of freezing is to have reliable cooling curves in order that a distinction may be made between slowly and rapidly frozen fish.

Since the water in fish muscle does not all freeze at a fixed temperature, but the various quantities frozen are dependent upon the temperature, it is difficult to calculate the time required to reduce the temperature of a

fish through the critical interval under given freezing conditions, mainly because of the variables involved. Any mathematical treatment would not only have to take into account the thickness of fish, the temperature of the cooling medium and the thermal and physical constants of the flesh, but would have to include the extent of the freezing and the changes in the various constants as freezing progressed. When dealing with a complex substance such as fish muscle it is not safe to assume that a thermal constant such as latent heat of fusion will remain constant through a given temperature range because the water frozen out leaves the remaining liquid richer in naturally occurring soluble salts, and it is reasonable to suppose that the latent heat will vary as the salt concentration varies. Therefore an equation such as that advanced by Langstroth* could not be expected to give very accurate results over the wide temperature range of the critical interval suggested.

Realising the value that curves from direct freezing experiments would have, further work is in progress at this Station to obtain the necessary data for the various kinds of commercial fish of this coast, when cooled according to the systems in common use. For illustrative purposes some of the results are given in Figs. 1 to 3.

The curve shown in Fig. 1 is a typical cooling curve for halibut, when freezing from both sides in a metal-faced container submerged in calcium chloride brine held at constant temperature (±1° F.) and gently agitated with a stirrer. The curve shows the relation between time and the temperature at the centre of the muscle, the fibres of which were perpendicular to the freezing surfaces of the container. That is, the fish was in the form of steaks. It will be seen that though it took about 80 minutes to reduce the temperature at the centre of the steak from +52° to −2° F., it took but slightly over 41 minutes for the temperature to be reduced through the critical zone 41° to 23° F. (*a* to *c*), and 30 minutes to pass through the zone 32° to 23° F. (*b* to *c*). According to the new definition, then, this fish could safely be called rapidly frozen.

Referring still to the curve in Fig. 1 it will be noticed that at the point *o* the curve flattens out, or the temperature remains constant momentarily. This is the temperature where ice crystals first begin to form and shows that the initial freezing point of the muscle is in the neighbourhood of 30° F. In one or two instances when cooling took place comparatively slowly, there was a slight depression in the curve to the left of *o*.

FIGURE 1.

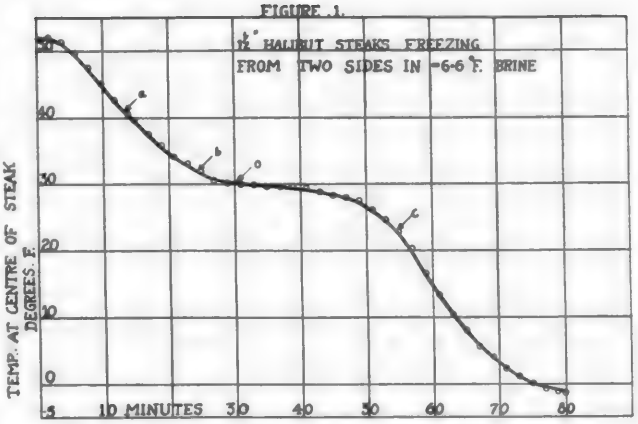


FIGURE 2.

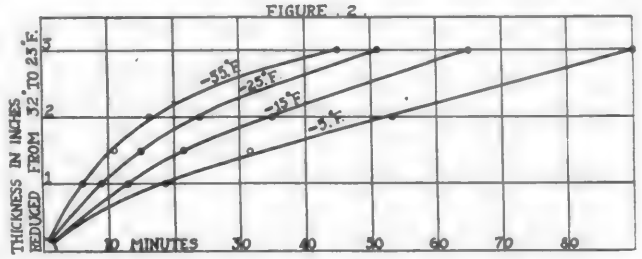
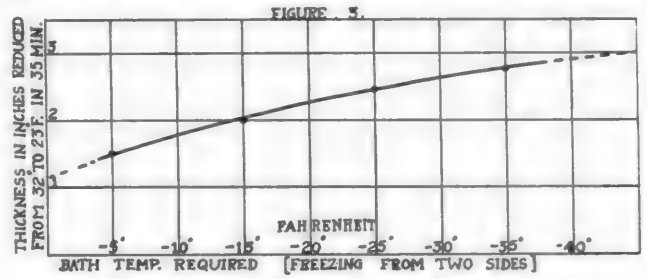


FIGURE 3.



* G. O. Langstroth, Contr. Canad. Biol. Fish., N.S. VI. 377-389. 1931.

The Bacteriological Laboratory at Prince Rupert, used for the study of factors affecting transportation facilities for fresh and frozen fish, the control of canned marine products, and the bacteriological discoloration of fresh fish.

That is, the temperature dropped slightly below 30° F. and then suddenly rose again, showing that under certain conditions the juices can be supercooled. Between *o* and *c* the most important phase of the freezing process is shown In this interval Finn (Progress Report No. 14, 1932) found that about 84 per cent. of the water crystallised out, so it will be seen that the number of crystals and therefore the average size of crystal will be controlled by the time taken to reduce the temperature through this zone. To the right of *c* the temperature drops very quickly, showing that the heat capacity is low.

Relations were also obtained between thicknesses of steaks and time required to reduce the temperature of the innermost portions through the zone 32° to 23° F., by varying the thicknesses of the steaks and the temperature of the cooling bath. Typical results are plotted in Fig. 2.

Asssuming the critical rate for fish to be 48 minutes for the interval 41° to 23° F. or 35 minutes for the zone of maximum crystal formation, then from the curves shown in Fig. 2 it is a simple matter to obtain a relation between thickness of steak and brine temperature necessary to reduce that thickness through the zone in the required time. A typical curve showing this relationship for the stated conditions is given by the curve in Fig. 3. It will thus be seen that the results of these experiments are unaffected by the *critical rate*, though they do involve an arbitrarily chosen critical zone on the temperature scale. So should it later be found that the critical cooling rate for fish is different from that suggested, the only curve that would be affected would be that shown in Fig. 3.

Laboratory for the study of the structure and polymerisation of fish oils at Prince Rupert.

It is planned to secure similar data for air-freezing, employing different temperatures when the air is moving under natural convection and at high velocities; also for the various brine systems including direct immersion, brine spray, and those employing indirect contact by the use of containers or metal belts.

A NOTE ON BACTERIA AND LOW TEMPERATURE STORAGE

The following note describing an interesting experiment has been taken from a report issued by the Biological Board of Canada in December, 1934.

By R. H. BEDFORD

Pacific Fisheries Experimental Station, Prince Rupert, B.C.

IT IS matter of economic importance to the cold storage section of the industry to know the effects of low temperature in controlling the growth of bacteria on fish. In order to determine this, a population of many different kinds of bacteria growing in minced halibut was frozen rapidly in brine, then stored at −10° C. (14° F.), −15° C. (5° F.), and −20° C (−4° F.). At certain periods thereafter the surviving numbers of the population were counted. The experiment has been in operation 220 days and is still being continued.

The results to date are outlined in the following table. They indicate that the number of bacteria surviving at −10° C. is much smaller than at either −15° or −20° C.

The significance of these results points to irreversible chemical changes having occurred at a much greater rate in the cells of those bacteria which have not survived the storage temperature of −10° C. It is quite probable that these irreversible chemical changes take the form of denaturation of the proteins of the cell protoplasm, primarily due to dehydration by freezing, which in turn causes changes in the hydrogen ion and salt concentrations of the bacterial cell. Such changes as these have been shown to be involved in the low temperature denaturation of the proteins of the juices of meat and fish; the rate at which this takes place being greater at −10° C. than at −20° C.

This means that the temperature of −20° C., which

Relative Populations of Surviving Bacteria after Storage at Low Temperatures.

	Days storage.					
Storage temperature.	0	115	178	192	206	220
−10° C. (14° F.)	100*	6·1	3·6	2·1	2·1	2·5
−15° C. (5° F.)	100	16·8	10·4	3·9	10·0	8·2
−20° C. (−4° F.)	100	50·7	61·0	57·4	55·0	53·2

* 100 is equivalent to 280,000 organisms. Incubation six days at 25° C.

is economically the best for preserving frozen halibut, also preserves the bacterial population to a greater extent than the higher temperatures of −10° C. and −15° C.

The questions then arise: (*a*) What is the condition of the live bacteria at −20° C. and lower—do they actually function as living organisms, and if so, what effect have they on fish during long periods of storage? (*b*) Has the greater bacterial population any particular significance after the fish have been thawed?

The answers to these questions are of practical importance to the cold storage industry, the retailer, and the consumer.

GROWTH OF MICRO-ORGANISMS AT AND BELOW 0° C.

The following interesting note is a summary of an important piece of work described in "Phytopathology," 1934, 24, 780-796.

By J. A. Berry and C. A. Magoon

Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, U.S. Department of Agriculture, Washington, D.C.

A review of the literature on the minimum temperature requirements of micro-organisms shows that:

Since 1887, numerous species, including even some of the pathogenic forms, have been observed to grow at 0° C. and, in some cases, considerably below that temperature. In general, the organisms developing at subzero temperatures are fungal rather than bacterial, though some bacterial growth has been observed.

Of these organisms developing at temperatures below −5° C. species of *Cladosporium* and *Sporotrichum* have been most commonly observed.

In general, following exposure to moderately low temperatures, *e.g.*, −5° to −6° C., there is a marked reduction in the number of viable organisms. Under aerobic conditions, however, this initial decrease may be followed by the actual increase of cold-tolerant moulds.

There is evidence that the development of moulds may take place at temperatures below those at which their spores can germinate. Spore germination of certain moulds, however, has been observed at temperatures as low as −7·78° C.

Any microbial growth below −10° C. seems unlikely.

Failure of an organism to grow at a subzero temperature may be due to ice formation in the medium rather than to the effect of cold alone, though apparently some microforms, particularly certain moulds, are less affected by ice formation than others.

Humidity and oxygen relationships are factors to be evaluated in a consideration of microbial growth at low temperatures.

No reported record has been found of the growth of *Clostridium botulinum* at subfreezing temperatures.

The writers' records show growth at −4° C. of *Pseudomonas fluorescens* and species of *Lactobacillus, Torula, Monilia,* and *Penicillium*. Growth of species of *Cladosporium* and *Sporotrichum* at −6·7° C., also, is reported. These organisms were isolated from frozen-pack fruits and vegetables and grown in pure cultures at the temperatures mentioned.

A graph shows the rate of growth of a strain of *Pseudomonas fluorescens* at −4° C.

Types of culture media suitable for use in the study of microbial growth at temperatures below 0° C. are considered.

The contention that a truly cold-loving or "psychrophilic" group of micro-organisms exists appears unwarranted by available evidence. While organisms recorded as growing at 0° C. or below may with propriety be regarded as forming a cold-tolerant group, their temperature requirements for best growth definitely place them in the mesophilic class.

A bibliography of 56 references is given.

2,000 Years Ago

Lard and Bears' Grease*

THE fatt of Swine & of Beares is prepared after this manner. Taking that which is new & grosse such as is that which growes vpon the kidnies, & the skinne being taken off, cast it into a good quantitie of very cold raine-water, rubbing it carefully with ye handes and as it were reviuing it againe. Then having washt it often in other water, put it into an earthen vessel that will hold twice as much as that commes to, and, putting in as much water as may couer the fatt, set it ouer a gentle fire of coales, & stirr it with a splatter; & when it is melted strain it through a strainer into water, & soe letting it coole; then putting out all the water gently from it, carefully put it againe into another vessell ready washt beforehand, & putting in water vpon it, melt it gently. Then hauing taken it downe, & suffered the dreggs to settle a little, put it out into a mortar moystened with a sponge. And when it is growne together, taking it downe, & taking off ye filth lying in the bottom, melt it againe the third tyme without water, and pouring it againe into ye mortar, and hauing made it cleane, put it vp into an earthen vessell, and hauing stopt it close, set it up in a very cold place.

* From *The Greek Herbal of Dioscorides*.—(Translated into English in 1655.)

Industrial News

SEEN AT THE B.I.F.—BOXES—HCN FUMIGATION—COLOUR MATCHING—"GELOZONE"—TEA SEED OIL—INVENTOR OF FAMOUS MILK TEST HONOURED—HOW AMERICANS MAKE THEIR ICE—CORROSION BY COOLING BRINES—WORLD-FAMOUS CHEF DIES

Seen at the B.I.F.

A most imposing array of their products, specially featuring "Drydex" and "Olio" flavours, was to be seen on the stand of Messrs. A. Boake, Roberts and Co., Ltd. "Drydex" flavours are made for incorporation in powders, "Olio" being an oil-soluble form.

A very fine exhibit, admirably arranged, was that of Messrs. W. J. Bush and Co., Ltd. It is impossible to indicate more than a few of the items in each of the several different classes, but we must mention their concentrated fruit juices, preserved with 50 per cent. of sugar. These were very fine, and about a dozen fruits were represented. Then there was Vanillin Bush 100 per cent., made from clove oil distilled from cloves at their own factory, and cream of tartar B.P. 99·5 to 100 per cent., also made at Ash Grove. Another special exhibit comprised harmless food colours for all types of foodstuffs; coumarin, used now for imparting a vanilla flavouring to ices, was also shown, together with a complete range of essential and terpeneless oils. Finally we must mention the very fine essences shown; almost every fruit was represented, including lime, banana, coconut, etc., and there was a honey essence.

Boxes

Messrs. Eburite Corrugated Containers, Ltd., were for the first time at the B.I.F. demonstrating the construction of their non-returnable paper-board ice-cream containers. These have been in regular use in the U.S.A. for some time, and they are now being increasingly used in this country. They are hygienic, and 80 per cent. lighter than metal cans, compared with which they represent a saving of 33⅓ per cent. of the direct cost.

HCN Fumigation

I.C.I. had an interesting exhibit showing how fumigation with HCN destroys citrus scale insects and promotes the growth of clean and healthy fruits. The exhibit included fruit infested with scale insects, and fruit from a fumigated tree. A number of sectionalised relief maps demonstrated the astonishing ramifications of this great group of firms.

An unusual and very attractive stand was that of Messrs. Robinson and Sons, Ltd., of Chesterfield. This was built up of cartons, among which it was possible to examine many interesting examples of their printed and lithographed cardboard boxes, including round, square, and folding designs.

Colour Matching

Messrs. Tintometer, Ltd., were displaying a new and very neat apparatus for colour matching in Nessler tubes; the facility with which the modern Lovibond Tintometer can be employed for colour measurement should now be known to everyone.

"Gelozone"

This was featured by Messrs. Whiffen and Sons, Ltd. It is, of course, very much used nowadays as a stabiliser in ice-creams, and it is stated to be proving very efficacious also in packs of many different foods, especially in meat and fish pastes for preventing breaking of emulsion and shrinkage. This very useful material is in powder form.

Messrs. Williams (Hounslow), Ltd., specialise in harmless colours for use in foodstuffs, and a very large range of materials was on show at their stand. This firm supplies a very useful colour card for reference purposes.

Tea Seed Oil

With the present high prices ruling for olive oil there should be an improved demand for tea seed oil (about which we published a trade note in the June, 1934, issue of our associated journal *The Manufacturing Chemist*) to replace it. The crude tea seed oil may contain traces of saponin, which would have to be removed before the oil could be used as a salad oil or for other edible purposes.

Messrs. Moreland and Co., of 4, Lloyds Avenue, London, E.C. 3, inform us that they are now in a position to supply the oil, guaranteed to be free from saponin. They have a few drums of the crude oil and also of oil from which saponins have been removed, and will be pleased to receive enquiries and forward samples.

Incidentally, Messrs. Moreland also say that they are in a position to supply any of the fats required in the manufacture of compound fats, information concerning which was requested in Enquiry 1,793 in the February issue of this journal. As this is by no means the first time we've had this enquiry (it's not even the first time we've published it!) we hope interested readers will take note.

Inventor of Famous Milk Test Honoured

In the University of Wisconsin there has recently been placed a memorial plaque of bronze, which will be a constant reminder of the inventor of the worldwide milk test used by dairymen to determine the butter fat content of milk. The plaque was designed by Lorado Taft and erected to the memory of Dr. Stephen Moulton Babcock, from whom the universally used Babcock test for milk gets its name.

A photograph of the bronze plaque.

How Americans make their Ice

The following item is of interest in connection with the articles dealing with refrigeration which appear elsewhere in this issue.

The manufacture of ice is an industry of considerable importance in America, where the high temperatures which are prevalent in summer make cold storage necessary if fresh food is to be kept in the house.

A cheap and convenient refrigerant for domestic use is "salt ice", which melts at a uniform temperature of $-6°$ F. It is manufactured by freezing brine so quickly that the salt has no opportunity to separate. Common salt is mixed with water, a mechanical agitator with monel metal shaft and blades being used, and the resulting brine is pumped into a tank in which revolve two watertight monel metal cylinders filled with freezing calcium chloride at a temperature of $-30°$ F. The thin film of salt ice which forms on the outside of the cylinders is peeled off and falls into a collecting bin.

▼ ▼ ▼

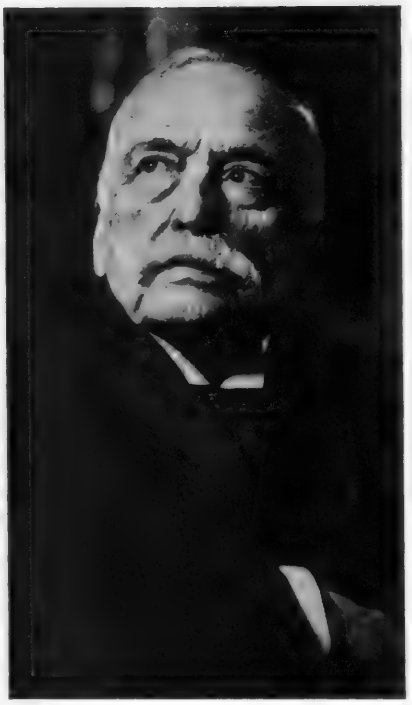
We have just heard of two important contracts, one in this country and one abroad, recently secured by The Liverpool Refrigeration Co., Ltd. They are to supply the refrigerating machinery for continuous process ice-cream hardening at $-65°$ F. to the Midland Counties Dairies, Ltd., at Birmingham, and Frontino Gold Mines have asked them for refrigerating equipment for meat storage in South America. The plant, which will be automatically controlled, includes a "Polar" single cylinder sleeve valve compressor.

Corrosion by Cooling Brines

In a series of experiments designed to test the ability of various metals to withstand corrosion by different types of cooling brines, Mietke and Witt (*Molkerei-Ztg.* [*Hildesheim*], 1934, **48**, 842-843) found that the degree of attack varies with the composition of the brine, but was relatively severe on the majority of the materials tested. Metals specified as showing resistance to attack considerably above the average were nickel-chromium austenitic steel, pure nickel, and nickel-copper alloy.

▼ ▼ ▼

A campaign for Fry's breakfast cocoa is now running in the provincial press through London Press Exchange, Ltd., says the *Advertiser's Weekly*.



World-Famous Chef Dies

M. Auguste Escoffier, France's "unofficial ambassador", as M. Herriot once called him, world-famous chef and inventor of the Pêche Melba, died on Tuesday, February 12, at the age of 88, at his home near Monte Carlo, to which he retired a number of years ago.

Although famous principally as chef and restaurant director—he had carried the renown of French cooking to England, America, Spain, Russia, Italy, India, and South Africa—and as director of the cuisine of the Savoy and later the Carlton, M. Escoffier also took great interest in the industrial or factory scale production of high-quality foods. He had in particular a great enthusiasm for fine soups, and on several occasions visited the soup kitchens of the Crosse and Blackwell factories.

One of M. Escoffier's own ventures in food manufacturing is still in active existence—Escoffier, Ltd., the pickle and preserve manufacturers, of Peckham—which firm the celebrated chef founded.

M. Escoffier achieved fame at a comparatively early age. Before he was 20 (in 1865) he was the chef of a fashionable Paris restaurant at which the then more numerous royal heads of Europe were frequent guests.

He came to London with M. Ritz in 1880, and, while chef at the Carlton, invented his famous Pêche Melba to please the celebrated prima donna, who asked him if he could combine the flavours of vanilla, peach, and raspberry in one perfect dish.

The author of a book, "A Guide to Modern Cookery", his genius was naturally respected in France. Four hundred of France's leading chefs and gourmets gave a dinner in March, 1928, in honour of M. Escoffier's nomination as Officer of the Legion of Honour. M. Herriot presided as head of the Department of Fine Arts.

British Goods in Canada

It is quite likely that conditions in Canada will change during the next few months in such a way that British products will enter the country which, on account of high tariffs, have been prohibitive during the past few years.

The Howell Warehouses, Ltd., of Toronto, Canada, have complete facilities not only for warehousing and shipping but also for light manufacturing, packaging, invoicing, collecting, etc. That is to say, the English manufacturer can have all the advantages of a Canadian plant, with his expenses, however, only increasing as the sales increase.

In addition to their packaging and manufacturing services this firm also operates an affiliated organisation, Richardson Agencies, Ltd., Canadian selling agents for a number of well-known lines and distributors throughout the wholesale and retail drug field, departmental and chain stores in Canada.

This firm is fully prepared to give all the references which may be required, and we think the British manufacturer is looking for the type of facilities which they have to offer.

Fire!

The Building Industries National Council, of 5, Duke Street, Adelphi, London, W.C. 2, recently published a Report on "Means of Escape from Fire", price 1s. 3d.

The Report deals for the first time in detail with the designing of buildings from the point of view of the provision of adequate means of escape in case of fire. Difficulties arising from the absence of defined regulations dealing with this matter, particularly in London, are met by setting out a logical sequence of factors and formulæ as a basis for the designing, construction, and equipment of modern buildings with adequate means of escape in case of fire.

While the matters dealt with in the Report are of particular and direct concern to all those engaged in the building industry, they are of equal interest to actual and prospective building owners and all concerned in the construction and equipment of modern buildings.

Increased European Sugar Output

According to F. O. Licht, the Magdeburg sugar statistician, there will be an increase in the production of sugar for the period 1934-1935 amounting to as much as 1,177,150 tons over that of the 1933-1934 campaign. Licht estimates the total European production (excluding Russia) to be 6,963,000 tons, compared with the previous year's 6,185,850 tons. Russia is expected to produce 1,500,000 tons, representing an increase of some 400,000 tons compared with the previous season.

Germany is the biggest European sugar producer, with an output of 1,675,000 tons. France comes next (if Russia is excluded) with 1,200,000 tons, and Great Britain third with 635,000 tons. It will be seen that although many countries hold large stocks of sugar from last year, production is increasing in nearly all European states. It would seem that European beet growers and sugar refiners anticipate that the recent increased consumption of sugar and sugar products will be maintained in the immediate future.

Control Instruments

Messrs. Short and Mason, Ltd., Aneroid Works, London, E. 17, send us particulars and leaflets descriptive of a large number of instruments designed and made by them.

Moisture control is effected by their Universal Hygrostat, which is available in two types, air operated and electric.

Volumetric pressure gauges and recorders are available for all types of homogenisers, viscolisers, etc., and among numerous other indispensable retort fittings may be mentioned their "single duty" direct set recording regulator, recording thermometers, a "Thermo-Tyme" temperature regulator (which controls two temperatures, or one temperature and one pressure), a pressure regulator, diaphragm valves, etc.

Expansion

We hear that Jack L. Barnett, Ltd., wholesale glass merchants, whose head office is at Leeds, have recently taken showroom accommodation at 103, Corn Exchange Buildings, Manchester (Tel. Blackfriars 0225—note this number, as an error in the local directory gives it as 0825). The showroom is open from 9 till 6, and their representative will do all in his power to make "Barnett for Bottles" a motto to remember.

Welfare in Industry

The first Welfare Pamphlet in the new series issued by the Home Office is entitled "Protective Clothing for Persons Employed in Factories and Workshops". It is priced 9d., and can be obtained from H.M. Stationery Office.

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In "A critical review of the literature relating to the hygienic properties of nickel in contact with foodstuffs", *Korrosion und Metallschutz* (1934, 10, 205-212), presents from the pen of W. Schreiber the first instalment of a report on a survey of literature made under the auspices of the German Ministry of Health. The results of experiments by numerous investigators are summarised in the article, with full references to the original literature.

Traders' Defence Association

The T.D.A. has just published a little booklet setting out in detail the new conditions arising out of the Road and Rail Traffic Act, 1933. Our readers will no doubt remember the notice in these columns dealing with the work of the Association in the October, 1934, issue of this journal.

We are interested to learn that membership of the Association is steadily increasing, and enquiries concerning its work and the service offered should be addressed to the Secretary at 37, St. Nicholas Street, Bristol.

British Association of Chemists

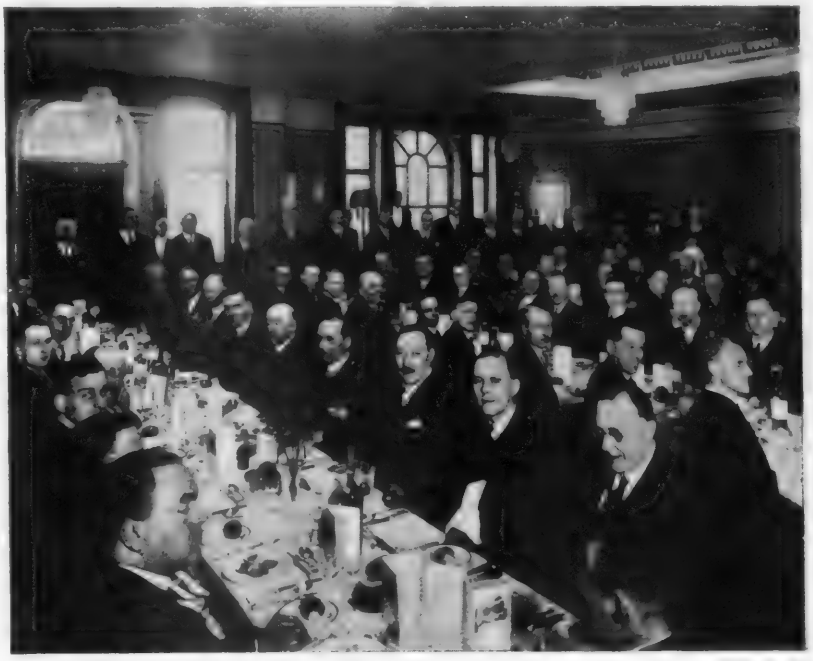
Prof. E. C. C. Baly, President of the British Association of Chemists, recently gave a lecture before the Notts and Derby Section of the Association on "The Conversion of Carbon Dioxide and Water into Sugar". The lecture proved a great success, an enthusiastic audience of 60 being present. Mr. J. F. Briggs, A.C.G.I., F.I.C., of Messrs. British Celanese, Ltd., presided.

Notice of Removal

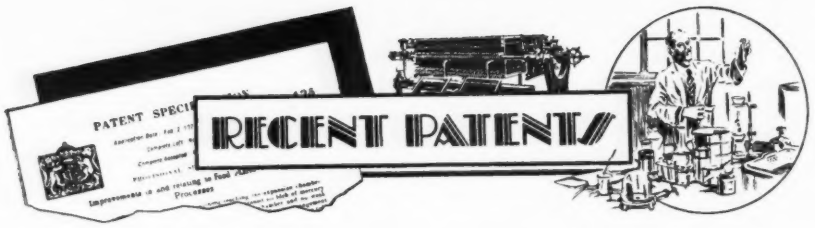
The name Pontifex has been associated with a City address in Shoe Lane for 146 years, but owing to the sale of their freehold they are taking the opportunity thus afforded to consolidate this business with that of their well-known West End branch, A. Emanuel and Sons, Ltd. The combined firms will be conducted under the trading title of Pontifex and Emanuel, at 9-13, George Street, Manchester Square, London, W. 1 (Tel. Welbeck 8201—8 lines).

▼ ▼ ▼

The Twelfth Annual Meeting of the American Society of Bakery Engineers, to be held at the Edgewater Beach Hotel, Chicago, opens on March 11. There is to be a four-day convention, and March 12 will be devoted largely to a discussion of materials.



Inaugural Luncheon at the Grand Hotel, Dover, on the occasion of the opening of the New Wheat and Flour Laboratories.



These particulars of New Patents of interest to readers have been selected from the "Official Journal of Patents", and are published by permission of the Controller of H.M. Stationery Office. The "Official Journal of Patents" can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C. 2, price 1s. weekly (annual subscription £2 10s.).

Latest Patent Applications

891,892. RODGERS, F. H. (SPRECKELS SUGAR CO.): Apparatus for recovering sugar. January 10.

160. JOOS, O. H.: Treating flour in flour mills. January 2. (Belgium, October 22, 1934.)

250. BEISSER, A.: Devices for preserving meat, etc. January 1. (Germany, February 26, 1934.)

544. HAMBURG, M., and JALOWETZ, E.: Production of coffee substitutes. January 7. (Austria, January 11, 1934.)

1188. PARSONS, M. L., and POOLEY, A. H.: Food-shredding utensils. January 14.

1212. VIVIAN, J. A.: Packing cheese. January 14.

1528. SCHACHTELKASEFABRIK F. ZWICK, and ZWICK, F.: Preserving cheese. January 16. (Germany, January 23, 1934.)

1529. SCHACHTELKASEFABRIK F. ZWICK, and ZWICK, F.: Preserving cheese. January 16. (Germany, September 26, 1934.) (Cognate with 1528.)

2192. CHEETHAM, T. H.: Pie-moulding machines. January 23.

2215. HANOVIA CHEMICAL AND MANUFACTURING CO.: Devices for irradiation of milk. January 23.

2444. STODDART, W.: Containers for ice-cream, etc. January 24.

2760. HECKERMANN, H.: Preservation of eggs. January 28.

2945. HURLIMAN, P. E., and SURREY CREAMERIES, LTD.: Packing, etc., cheese. January 29.

2990, 2991. IMPERIAL CHEMICAL INDUSTRIES, LTD.: Preparation of baked cereal foodstuffs. January 29. (United States, January 29, 1934.)

3171. STILL AND SONS, LTD., W. M., and STILL, F. G.: Coffee infusers. January 31.

3302. CURTIS, A. B.: Cream, etc., containers. February 1.

3456. BERKEL AND PARNELL'S SLICING MACHINE MANUFACTURING CO., LTD. (MAATSCHAPPIJ VAN BERKEL'S PATENT NAAMLOOSE VENNOOTSCHAP): Slicing machines. July 26, 1934.

3716. HEYMAN, E.: Foodstuff wrappings. February 5.

Complete Specifications Accepted

422,491. GIBBON, S. H.: Treatment of rice, rice offals, or paddy and the like. (Cognate Applications 20991/33 and 34225/33.)

423,063. KRONBERG, N. M.: Manufacture of milk powder. (Addition to 405,192.) (Convention date not granted.)

423,083. PEAKE, H. E. J.: Manufacture of fermented beverages and medicinal preparations. (Cognate Application 25370/34.)

423,086. BECK, A.: Refining of chocolate masses and similar masses.

Printed copies of the full Published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C. 2, at the uniform price of 1s. each.

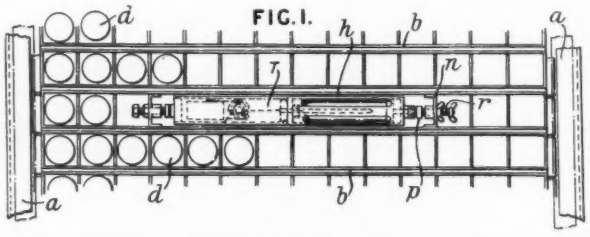
Abstracts of Recent Specifications

Group Abridgments can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C. 2, either sheet by sheet as issued on payment of a subscription of 5s. per Group Volume, or in bound volumes price 2s. each.

419,518. **Pasteurising and sterilising liquids; preserving food.** WEBSTER, R. W., Abbey Iron Works, Waltham Cross, Hertfordshire. Group VI.

In apparatus for pasteurising or sterilising bottled liquids such as beer and milk and jam or other foods in which the bottles *d* are conveyed on carriers, trays, or baskets *b* attached to endless chains *a* through a

FIG. I.



series of tanks containing water of varying temperature, a recording thermometer T is so mounted on one of the carriers *b* that it automatically assumes a true recording position irrespective of the rotary or other movement of the carrier *b*. As shown, the thermometer is enclosed in a casing *b* having at each end a centring disc *p* with a countersunk centre adapted to be engaged by the correspondingly shaped end of a set screw *r* carried by a channel *n* fixed to the carrier *b*. The casing *b* can swing or rotate in the carrier, but has a weight to cause it to assume the true recording position.

419,988. **Mincing machines.** WARD, LTD., T. W., and ELLIOTT, F., Savile Street, Sheffield. Group VI.

In a meat chopping or mincing machine the knives are spaced and carried by washers or carriers which are keyed or connected together in such manner that when the knives are disassembled and reassembled on the knife shaft the angular relationship of the knives cannot be disturbed. As shown, the knife shaft 7 has a collar 8 into which two screws 9, 10 are threaded, the heads of the screws projecting from the collar 8 to engage holes 29, 30 in the washer or carrier 16. The knife 13 is screwed to the face of the carrier 16 by screws, similar to the screws 9, 10, the heads of which engage holes in the carrier 15, which in turn has the blade 12 secured to it, and so on. The final screws 17, 18 are accommodated in recesses or apertures in a ring 43, which is clamped by a nut 46 to secure the whole assembly of knives 11—13 and carriers 14—16. The shanks of the knives, as shown in Fig. V, embrace the shaft 7 and are slotted at 31, 32 to permit radial adjustments of

FIG. V.

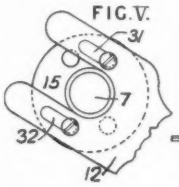
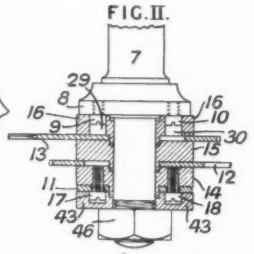


FIG. II.



the knives to compensate for recession of the edge due to wear. To prevent the carriers and knives from being assembled with incorrect relative angular positions, the screws 9, 10, etc., and the corresponding holes 29, 30, etc., may be arranged otherwise than on a diameter, or one set of screw heads and the corresponding holes may be made of different size to the other set of heads and holes. As shown, however, the correct angular relationship is assured by arranging one set of screw heads and the corresponding holes at a different radial distance from the axis than the other set of heads and holes. The carriers 14——16 are spigoted and socketed to engage with one another.

421,429. **Drying orange pulp.** SARDIK, INC., 305, East 45th Street, New York, U.S.A.

A process already described in E.P. 409,727, the basic feature of which is the drying of very finely divided individual particles of vegetable cellular products upon a rotating drum, is now claimed to be applicable to citrus fruits, particularly oranges. The orange pulp is separated from the rind and as far as possible from the white tissue between the rind and the pulp, care being taken to avoid introduction of oil from the rind into the pulp. Trapped air is removed from the latter by passage through a vacuum, and if this process cannot be applied immediately the pulp should preferably be kept in the interval in a carbon dioxide atmosphere. The main feature of the drying apparatus to which the air-free, finely divided pulp is next pumped is a rotary, internally heated drum, upon the outer surface of which the fine particles are distributed. In this apparatus elimination of water from the pulp takes place with sufficient

rapidity (in about fifteen seconds) at a temperature of about 175° F. to avoid injury to the vitamins, esters, and other desirable ingredients of orange pulp. (Convention date, U.S.A., February 13, 1933.)

421,554. **Salts of organic acids as common salt substitutes.** S. MICHAEL, The University, Edgbaston, Birmingham.

The products specified are based upon the discovery that salts in which both anion and cation undergo decomposition in the human body are free from certain therapeutic drawbacks of common salt substitutes hitherto available. Types of salts specified include ammonium salts of aliphatic hydroxy acids and salts of aliphatic hydroxy acids with aliphatic bases containing one or more amino groups and two or more hydroxy groups. Individual salts of these classes, however, suffer from the drawback of an unpleasant acid flavour, which can be suppressed by mixing with one another in a special manner —as, for example, by simultaneous crystallisation or precipitation. Incorporation of lactose, starch, or other indifferent substance also suppresses the unpleasant flavour. *Examples:* 150 gm. tartaric acid and 67 gm. malic acid are dissolved together in alcohol and the solution saturated with dry ammonia gas when the mixed ammonium salts are precipitated. 222 gm. calcium gluconate and 250 gm. anhydrous calcium citrate are treated with 284 gm. ammonium oxalate and the filtrate (after removal of the precipitated calcium oxalate) is concentrated before precipitating the salt mixture by addition of alcohol and a little ammonia.

421,631. **Fresh fruit juice beverages.** CONSERVENFABRIK LENZBURG AND SCHLOR, J., Niederlenzerkirchweg 735, Lenzburg, Aarau, Switzerland.

To overcome the drawback of the resinous flavour which natural bottled fruit juices are liable to develop after a comparatively short time owing to chemical changes of the natural essential oils, it is proposed to eliminate the latter by subjecting the fresh fruit juice to a vacuum at moderate temperature and then introducing a stable flavouring principle of the non-essential oil type—*e.g.*, ginger or vermouth. *Example:* 800 litres of fresh apple or pear juice are warmed to 28° to 35° C. in a 1 cubic metre jacketed vessel and maintained under a 20-millimetre vacuum for half an hour while being well stirred. The essential oil-free juice is then run off, cooled to 4° to 6° C., and a flavouring solution added comprising 800 litres water, 40 gm. sugar, and 40 gm. ginger. The treated juice is then saturated with 320 gm. carbon dioxide, again with thorough agitation, and allowed to stand for two days under 2 atmospheres pressure before bottling in the cold under sterile conditions. This product is said to keep for five to six months as compared with two to three weeks ordinarily. The same method can be applied to the manufacture of mixtures of apple and lemon, orange or pineapple juice.

NEW COMPANIES

BLACK DIAMOND PRODUCE COMPANY, LIMITED. 5, Duke Street, Tooley Street, S.E. 1. To carry on bus. as mnfrs. of and dlrs. in butter, margarine, and other fat and oil products, etc. Nom. Cap.: £3,000.

COLONIAL AND FOREIGN FRUIT AND PRODUCE, LIMITED. To carry on the bus. of exporters and importers, shippers and mnfrs. of and dlrs. in fruit, vegetables, farm and garden produce, etc. Nom. Cap.: £50,000. Subs.: A. G. Maby, 5, Thavies Inn, E.C. 1; B. T. Ford, 5, Thavies Inn, E.C. 1.

DAWSON (BAKERS), LIMITED. To take over the bus. of a baker and confectioner cd. on by E. Dawson at 8, Windmill Street, Tunstall, Stoke-on-Trent. Nom. Cap.: £1,000.

EGG PACKING MATERIALS, LIMITED. To acquire the benefit of certain existing inventions relating to the mnfr. of cartons for packing eggs, etc. Nom. Cap.: £20,000. Subs.: C. N. Barton, 119, Worple Road, S.W. 20; R. G. Barrett, Thrae, West Way, Rickmansworth, Herts.

HARGREAVES SHREDDED SUET, LIMITED. 18, Birley Street, Blackpool. To take over the bus. of a shredded refined suet mnfr. cd. on by H. Hargreaves at Blackpool. Nom. Cap.: £1,000.

MALVERN SWEET COMPANY, LIMITED. Royal Well Springs, Malvern, Worcs. To carry on the bus. of mnfrs. of sweets, chocolates, etc. Nom. Cap.: £100.

MIDGLEY AND ROBINSON, LIMITED. To carry on the bus. of pie mnfrs., pork butchers, etc. Nom. Cap.: £2,000.

MURPHY'S CRISPS, LIMITED. 49, Felsham Road, Putney, S.W. 15. To carry on the bus. of bakers, etc. Nom. Cap.: £300.

PRIMROSE DAIRY (CORNWALL), LIMITED. To take over the bus. of a dairy produce mnfr., etc., cd. on by M. L. Oats at Primrose Sancreed, Cornwall, and elsewhere. Nom. Cap.: £10,000.

STREAMLINE CHOCOLATE AND CONFECTIONERY COMPANY, LIMITED. To carry on the bus. of mnfrs. of chocolates, sweets, etc. Nom. Cap.: £100. Subs.: A. E. Isemonger and C. P. Staples, both of 199, Piccadilly, W.

TIP-TOP PRODUCTS, LIMITED. Pickle Factory, Wells Street, Rugby. To carry on the bus. of mnfrs. of and dlrs. in sauces and pickles, etc. Nom. Cap.: £500.

"TWICY-KOOLD" ICES, LIMITED. 94, Ladbroke Grove, W. 11. To carry on the bus. of mnfrs. and mchts. of ice-cream, etc. Nom. Cap.: £2,000.

The above-mentioned particulars of new companies recently registered have been extracted from the daily register of Messrs. Jordan and Sons, Ltd., company registration agents, Chancery Lane, W.C. 2.

RECENT TRADE MARKS (Continued from page 108.)

Registration of this trade mark shall give no right to the exclusive use, either separately or in combination, of the words "Mary Brett's" and "Roast Pawkies".

SNOW KING.—556,432. **Sugar.** BURTON, SON AND SANDERS, LTD., 8, College Street, Ipswich; and St. Peter's Wharf, Ipswich. January 23.

556,792. **Substances used as food or as ingredients in food.**

MELTIS, LTD., 158, Drummond Road, London, S.E. 16. February 6. (Associated.)

SUNBONNET.—554,868. **Margarine.**

N. KILVERT AND SONS, LTD., Trafford Park Road, Trafford Park, Manchester. January 23. (Associated.) (By Consent.)

SUPREMANCO. — 557,133. **Substances used as food or as ingredients in food.** SUPREME MANUFACTURING CO., LTD., 58, Weaman Street, Birmingham, 4. February 13.

SUSSEX DINNER.—554,297. **Tinned food preparations consisting of cooked meats and mixed vegetables.**

WILLIAM ROSS CHAMBERLIN ASHBY, trading as Amos Brett and also as Mary Brett, Fen Pond Farm, Ightham, Kent, and The Warren, Church Road, Woldingham, Surrey. January 23. (Associated.)

Registration of this trade mark shall give no right to the exclusive use, either separately or in combination, of the words "Mary Brett's" and "Sussex Dinner".

The application undertakes to use the mark only on meat and vegetables produced in Sussex.

TABLEAU.—555,408. **Biscuits.** BEE BEE BISCUITS, LTD., Sutherland Road, Blackpool. January 23.

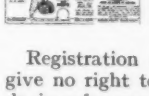
555,860. **Edible vegetable fat compound for use in connection with the bakery trade.**

KIRBY'S REFINERIES, LTD., Albion Works, Clack Street, Rotherhithe, London, S.E. 16. February 13.

Registration of this trade mark shall give no right to the exclusive use of the letter "K".

TOTEM.—556,547. **Brown flour and cereal breakfast foods.** CO-OPERATIVE WHOLESALE SOCIETY, LTD., 1, Balloon Street, Manchester. January 23.

VI-COCOA. — 554,619. **Preparations of cocoa.**



The firm trading as A. C. FINCKEN AND CO., 197, Great Portland Street, London, W. 1. February 6. (Associated.)

Registration of this trade mark shall give no right to the exclusive use of the device of a cup of cocoa.

WARIGAL.—556,748. **Australian canned, dried, and bottled fruits.** CHARLES ARKCOLL, LTD., 29 to 33, Stone Street, Maidstone, Kent. January 23.

RECENT TRADE MARKS

This list of Trade Marks of interest to readers has been selected from the "Official Trade Marks Journal", and is published by permission of the Controller of H.M. Stationery Office. The "Trade Marks Journal" can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C. 2, price 1s. weekly (annual subscription £2 10s.).

BLUE CIRCLE.—553,495. **Yeast.** PREMIER YEAST CO., LTD., 8, King William Street, London, E.C. 4. February 13.

Registration of this trade mark shall give no right to the exclusive use of the word "Premier".

The trade mark is limited to the colours blue and black, as shown in the representation on the form of application.

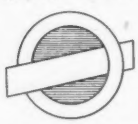
BOTH WELL.—553,296. **Substances used as food or as ingredients in food, but not including chocolate confectionery, sugar confectionery, or flour confectionery, and not including any goods of a like kind to any of these excluded goods.** PAUL KUNZLE, Bothwell Bank House, Bothwell, Scotland. January 23.

Registration of this trade mark shall give no right to the exclusive use of the words "Both Well".

BRITISH GIRL.—554,800. **Lard (for food).** LIJEMPF (LONDON), LTD., 46, Fish Street Hill, Eastcheap, London, E.C. 3. January 23.

The applicants undertake to use the mark only on lard produced in Great Britain.

554,696. **Substances used as food; and ingredients in the making of bread, cakes, and confectionery.** BADEX, LTD., Ashburton Road, Trafford Park, Manchester. February 6.



The trade mark is limited to the colours blue and white, as shown in the representation on the form of application.

CORONA.—541,357. **Fruit beverages (not alcoholic, not aerated, and not medicated), fruit essences (not alcoholic), for use as food, fruit juices (not alcoholic), and fruit syrups (not alcoholic and not medicated).** THOMAS AND EVANS, LTD., 24, Hannah Street, Porth, South Wales. January 23. (Associated.) (By Consent.)

Registration No. 325,901 (1701) will be cancelled, and essences and sauces will be struck out from the goods of Registration No. 535,811 (2867) if and before the applicants' mark is registered.

COUSIN KATE'S. — 551,203. **Canned meats in paste form, and pastes composed of chopped meats, poultry, fish, vegetables, or cheeses, or mixtures thereof, for use in making sandwiches.** WALTER SCOTT FRASER, East Main Street, Picton, Prince Edward, Ontario, Canada. January 23. (By Consent.)

ENDEAVOUR.—554,232. **Canned grapefruit.** GRAPEFRUIT DISTRIBUTORS, INC., Davenport, State of Florida, United States of America. January 23. (By Consent.)

ENERPLUS.—556,577. **Biscuits, shortbread, cakes, and chocolate.** WILLIAM CRAWFORD AND SONS, LTD., Fairfield Biscuit Works, Binn's Road, Liverpool. January 30.

FARMHOUSE DINNER. — 554,296. **Tinned food preparations consisting of cooked meat and mixed vegetables.** WILLIAM ROSS CHAMBERLIN ASHBY, trading as Amos Brett and also as Mary Brett, Fen Pond Farm, Ightham, Kent, and The Warren, Church Road, Woldingham, Surrey. January 23. (Associated.) (By Consent.)

Registration of this trade mark shall give no right to the exclusive use, either separately or in combination, of the words "Mary Brett's" and "Farmhouse Dinner".

GALLIASEC.—552,689. **Milk in powder form (for food).** SOCIÉTÉ ANONYME DES FROMAGERIES CH. GERVAIS, 11, Rue de Prony, Paris, France. January 23. (Associated.)

Registration of this trade mark shall give no right to the exclusive use of the word "Galliasec".

GOLDEN GRAIN.—B555,628. **Self-raising flour.** R. AND J. TEMPLETON, LTD., 146, Argyle Street, Glasgow, C. 2. January 30. (By Consent.)

User claimed from January 1, 1919.

GRASSHOPPER.—554,026. **Cheese, butter, and lard (for food).** CHAS. BODEGA AND SONS, LTD., 37, Farringdon Road, London, E.C. 1. January 30.

IFCA. — 552,850. **Chilled, frozen, and canned meat and edible fats.** The firm trading as C. A. GRONDONA AND CO., 25, de Mayo 33, Buenos Aires, Argentina. January 30.

IVY.—555,131. **Condensed milk.** MACPHERSON, TRAIN AND CO., LTD., Adelaide House, London Bridge, London, E.C. 4. January 23.

JOHN PEEL.—555,435. **Sausage, pies, cakes, and cream.** GARRICK'S (CATERERS), LTD., 47, Grey Street, Newcastle-upon-Tyne. February 13.

Registration No. 380,748 (2079) will be cancelled if and before the applicant's mark is registered.

JOY-DAY. — 555,584. **Canned fruits, canned vegetables, canned meats, butter, cheese, margarine, and eggs.** A. J. MILLS AND CO., LTD., Colonial House, Tooley Street, London, S.E. 1. February 6.

KING ALFRED.—555,981. **Fresh fruits and fresh vegetables (for food).** GRANGE GARDENS, LTD., The Grange, Abbotstone Road, Northington, Alresford, Hampshire. February 6.

The above-mentioned goods and goods of a like kind will be struck out from the goods of Registration No. 267,759 (1399) if and before the applicants' mark is registered.

L.B.W.—556,895. **Lemon flavoured barley water.** L.B.W., LTD., 41, Eastcheap, London, E.C. 3. February 13. (Associated.)

Registration of this trade mark shall give no right to the exclusive use, either separately or in combination, of the letters "L.B.W." and the devices of slices of lemon.

MAXIMORE.—556,579. **Biscuits, shortbread, cakes, and chocolate.** WILLIAM CRAWFORD AND SONS, LTD., Fairfield Biscuit Works, Binn's Road, Liverpool. January 23.

OZONE.—553,481. **Oysters, blue cod-fish and cray-fish.** STEWART ISLAND CANNERIES, LTD., 43, Clyde Street, Invercargill, Southland, Dominion of New Zealand. February 6. (By Consent.)

554,986. **Preparations of wheat for human consumption.** ENGLISH GRAINS CO., LTD., Shobnall Road, Burton-on-Trent. February 13.

Registration of this trade mark shall give no right to the exclusive use of the devices of ears of corn.

PARL VALLEY.—556,539. **All goods in Class 42, which includes substances used as food or as ingredients in food.** A. B. GIBSON, LTD., 61, Parliament Street, Nottingham. January 30. (By Consent.)

PIXIE.—555,296. **Sild, sardines, herrings, and shellfish.** BERGEN PRESERVING CO. AKTIESELSKAP, Kjöbmandsstuen, Tyskebryggen, Bergen, Norway. January 23.

Registration of this trade mark shall give no right to the exclusive use of the device of a tin of fish.

ROAST PAWKIES.—554,299. **A tinned food preparation consisting of cooked roast pork and mixed vegetables.** WILLIAM ROSS CHAMBERLIN ASHBY, trading as Amos Brett and also as Mary Brett, Fen Pond Farm, Ightham, Kent, and The Warren, Church Road, Woldingham, Surrey. January 23. (Associated.) (By Consent.)

(*Continued on page 107.*)